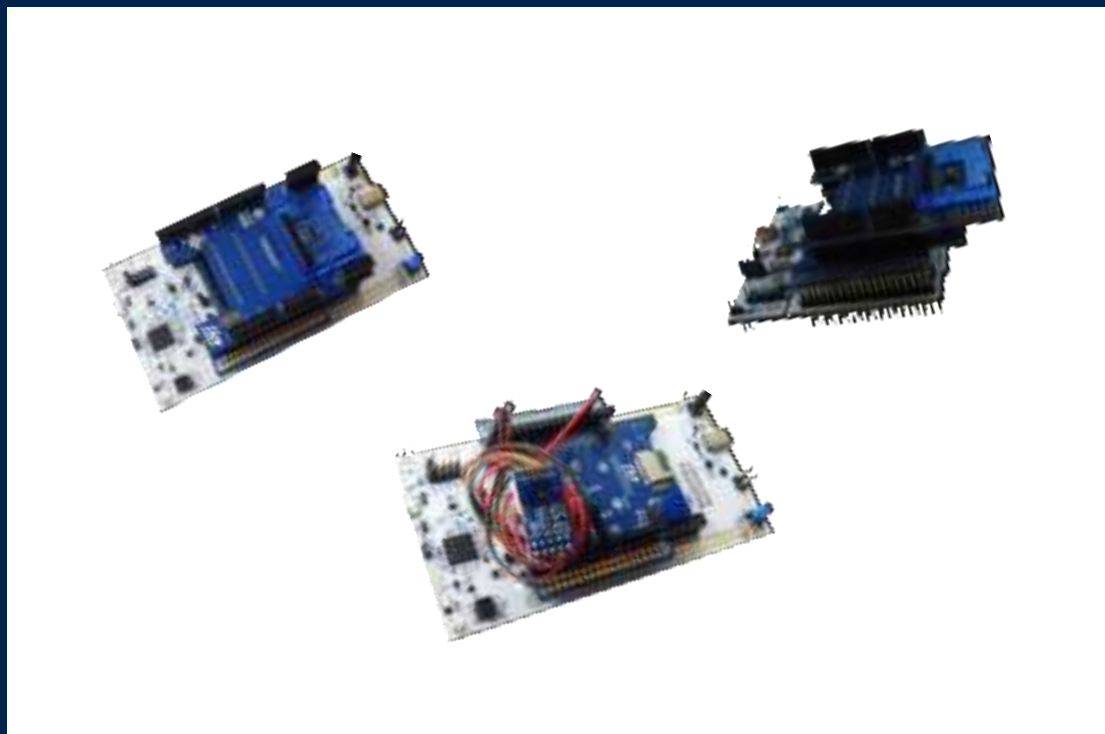# Quick Start Guide

STM32Cube function pack for IoT node BLE connectivity and time-of-flight sensors (FP-SNS-FLIGHT1)

Version 4.1 (January 31, 2025)

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

Sample implementations are available for STM32 Nucleo development boards plugged on STM32 Nucleo expansion boards:

➤ NUCLEO-F401RE (or NUCLEO-L476RG or NUCLEO-U575ZI-Q) + X-NUCLEO-BNRG2A1 + X-NUCLEO-53L3A2
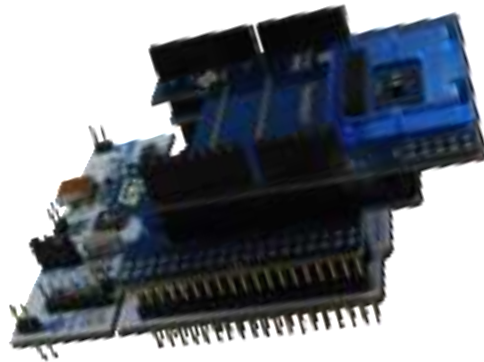
➤ NUCLEO-F401RE (or NUCLEO-L476RG or NUCLEO-U575ZI-Q) + X-NUCLEO-BNRG2A1 + VL53L3CX-SATEL
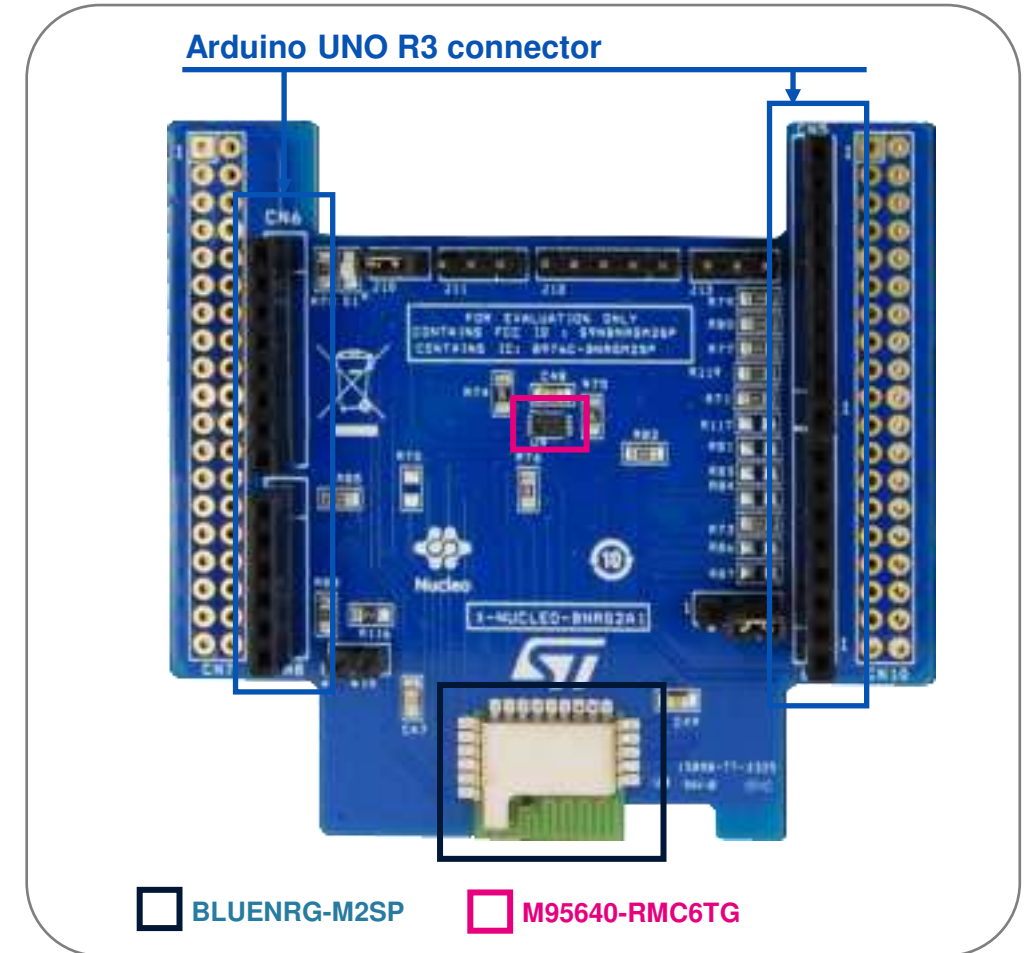
Hardware Description

- The X-NUCLEO-BNRG2A1 is a Bluetooth Low Energy (BLE) evaluation and development board system, designed around ST's BLUENRG-M2SP Bluetooth Low Energy module based on BlueNRG-2.

- The BlueNRG-2 processor hosted in the BLUENRG-M2SP module communicates with the STM32 microcontroller, hosted on the Nucleo development board, through an SPI link available on the Arduino UNO R3 connector.

Key Product on board

- BLUENRG-M2SP Bluetooth Low Energy, FCC and IC certified (FCC ID: S9NBNRGM2SP, IC: B976C-BNRGM2SP), module based on Bluetooth® Low Energy wireless network processor BlueNRG-2, BLE v5.0 compliant.

- BLUENRG-M2SP integrates a BALF-NRG-02D3 balun and a PCB antenna. It embeds 32 MHz crystal oscillator for the BlueNRG-2.

- M95640-RMC6TG 64-Kbit serial SPI bus EEPROM with high-speed clock interface

Arduino UNO R3 connector

☐ BLUENRG-M2SP ☐ M95640-RMC6TG
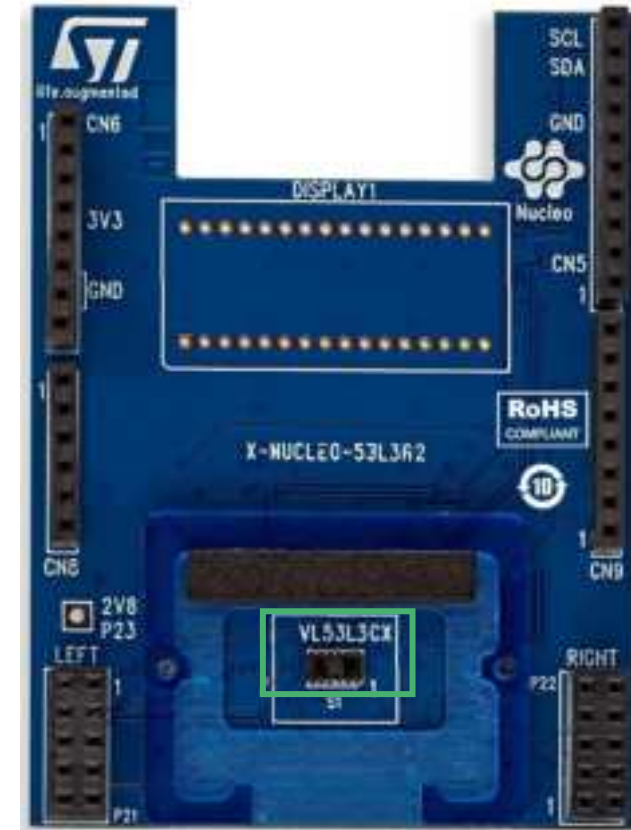
X-NUCLEO-53L1A2 Hardware Description

- The X-NUCLEO-53L3A2 is a ranging sensor with multi target detection evaluation and development board designed around the VL53L3CX sensor based on ST FlightSense™ Time-of-Flight technology.

- The VL53L3CX communicates with the STM32 Nucleo developer board host microcontroller through an I2C link available on the Arduino UNO R3 connector.

Key Product on board

- VL53L3CX Time-of-Flight (ToF) ranging sensor with multi target detection

- 0.25, 0.5 and 1mm spacers to simulate air gaps, with the cover glass

- Cover window (made by Hornix) sample with low cross-talk ready to use / clipable on VL53L3CX

- Two VL53L3CX breakout boards

☐ VL53L3cx

VL53L3CX-SATEL Hardware Description

- The VL53L3CX-SATEL breakout boards can be used for easy integration into customer devices. Thanks to the voltage regulator and level shifters, it can be used in any application with a 2.8 V to 5 V supply.

- The PCB section supporting the VL53L3CX module is perforated so that developers can break off the mini-PCB for use in a 2.8 V supply application using flying leads.

Key Product on board

- VL53L3CX Time-of-Flight (ToF) ranging sensor with multi target detection

- Regulator: 5 to 2.8 V range input voltage (output voltage: 2.8 V)

- VL53L3CX signal interface level shifter
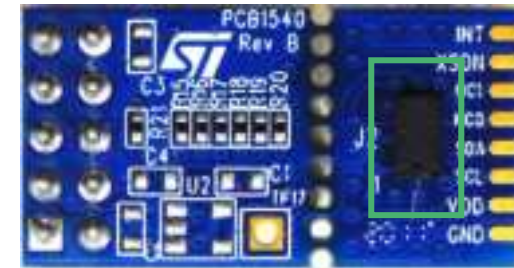
☐ VL53L3cx

Latest info available at www.st.com
VL53L3CX-SATEL

Important Hardware Additional Information

BlueNRG-2 library does not work with the stock firmware that is loaded in the BLE module of X-NUCLEO-BNRG2A1 expansion board.

For this reason:

- first of all, it is needed to solder on X-NUCLEO-BNRG2A1, if it is not soldered, a 0 Ohm resistor at R117.

- Then you can use a standard ST-Link V2-1 with 5 jumper wires female-female together with STSW-BNRGFLASHER software tool (currently available only for Windows PC) in order to update the firmware of the BLE module of X-NUCLEO-BNRG2A1.

You need to connect the J12 pins of the X-NUCLEO-BNRG2A1 to the pins of the ST-Link V2-1 as shown in the picture and follow the steps show in the next slide.
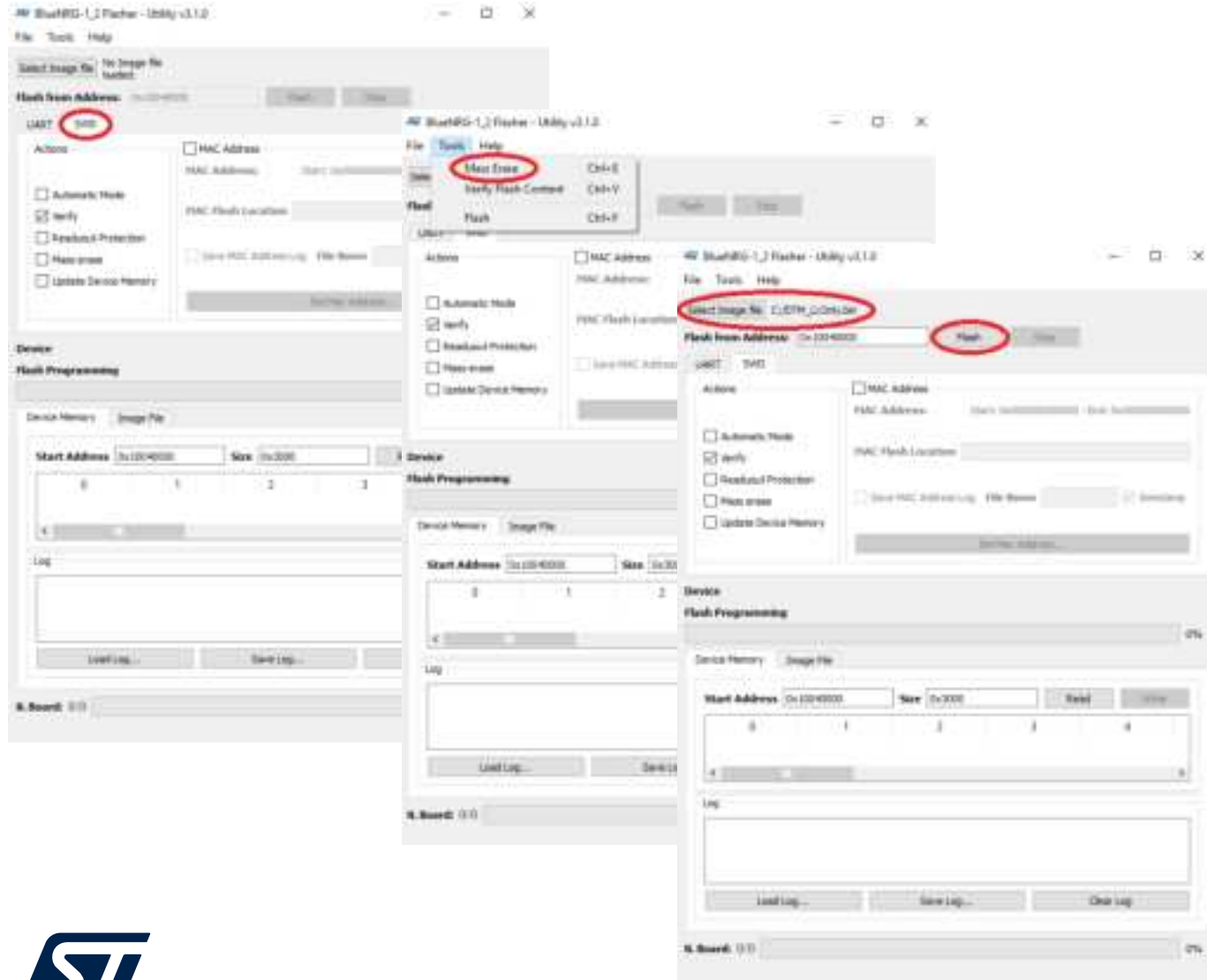
In particular we have the following connections:

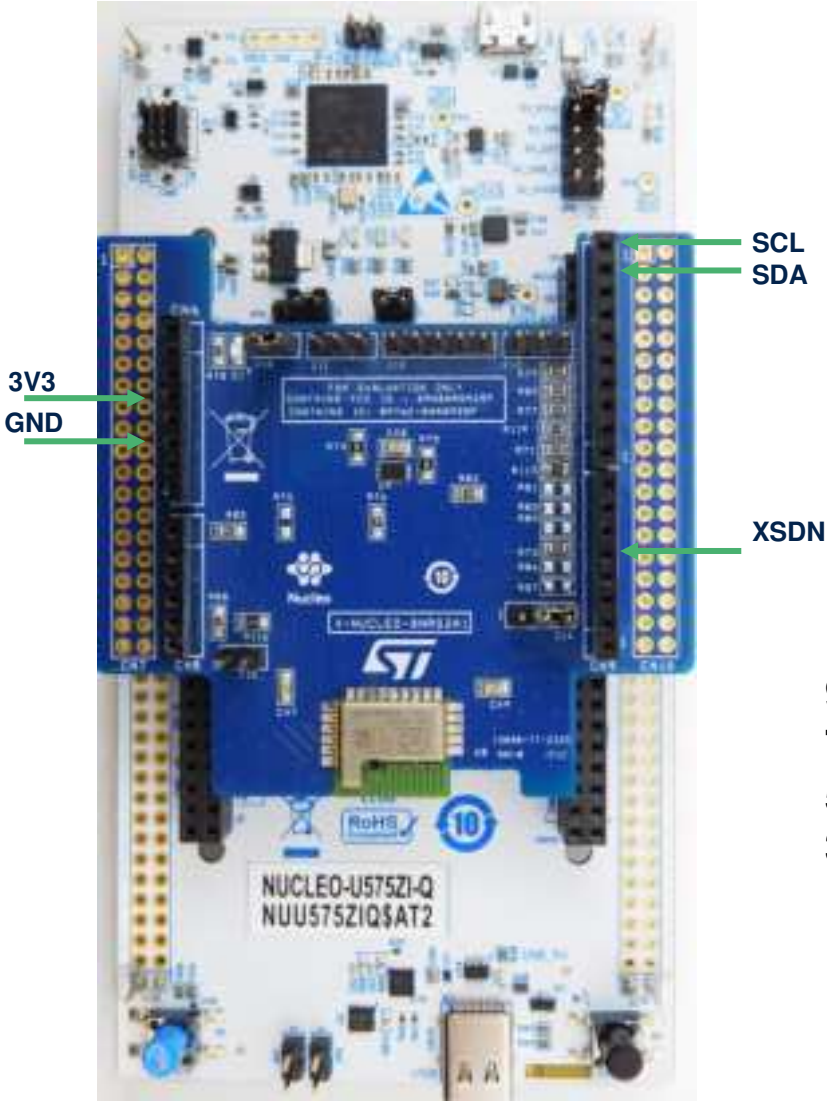|	J12	ST-Link V2-1
Pin	1	1
Pin	2	9
Pin	3	12
Pin	4	7
Pin	5	15

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1. install the ST BlueNRG-1_2 Flasher Utility and open it, then select the SWD tab

2. Erase the flash memory of the BlueNRG-2 chip

3. Download the Link Layer Only firmware for the BLE module from the following link DTM_LLOnly.bin

4. Load the Link Layer Only firmware in the ST BlueNRG-1_2 Flasher Utility and then press the "Flash" button

5. If you need to restore the stock firmware of the BLE module of X-NUCLEO-BNRG2A1, you can repeat the procedure using this firmware image DTM_Full.bin

6. If you should find some issues during the update process, you can try to repeat the procedure closing the J15 jumper on the X-NUCLEO-BNRG2A1 expansion board.

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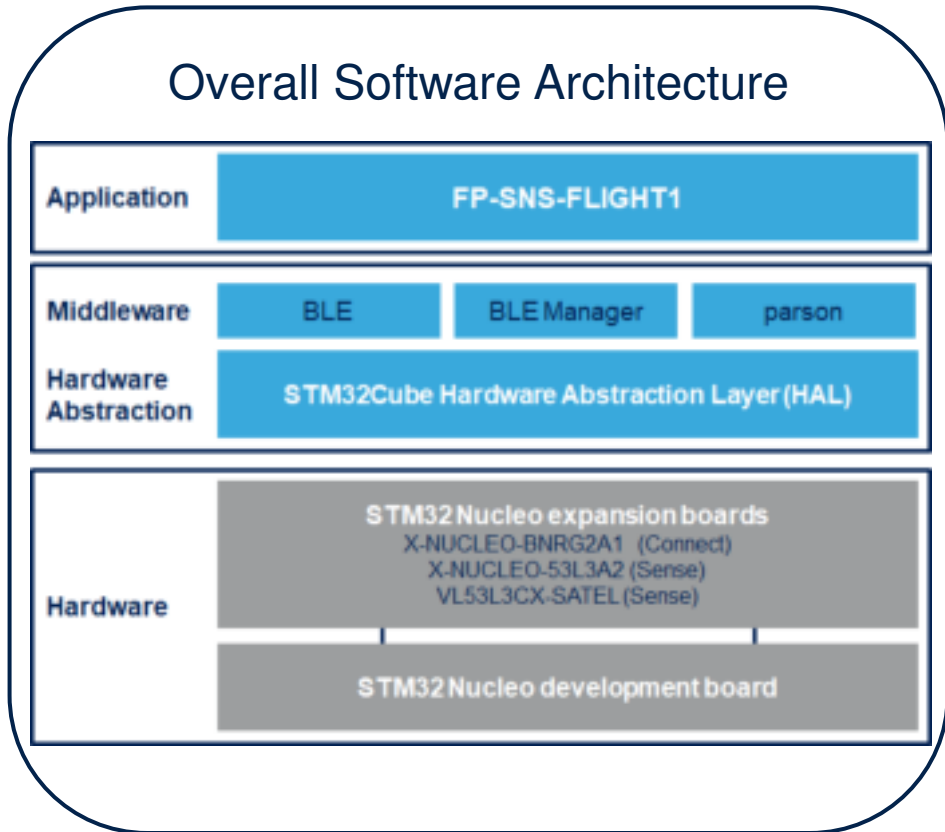|	VL53L3CX-SATEL	Arduino Connector	NUCLEO-F401RE NUCLEO-L476RG	NUCLEO-U575ZI-Q
SCL	2	D15	PB8	PB8
SDA	4	D14	PB9	PB9
XSDN	3	D4	PB5	PF14
VDD_SENSOR	5	3V3	CN6 pin n. 4	CN8 pin n. 7
GND_X	6	GND	CN6 pin n. 6	CN8 pin n. 11
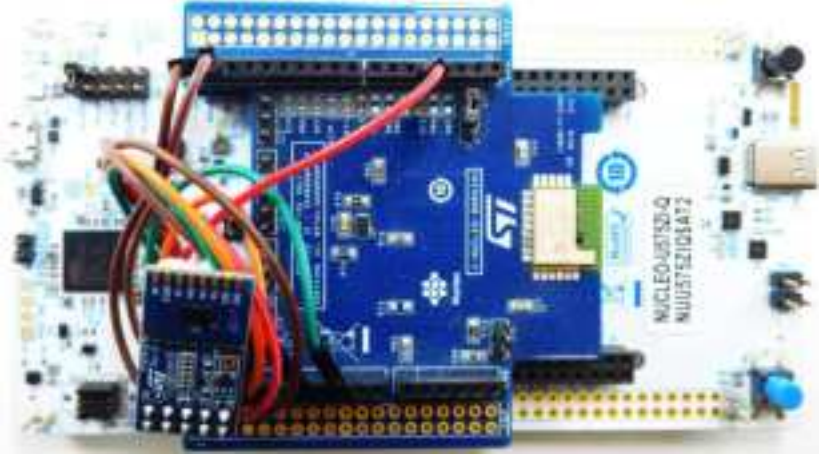
Software Description

- The FP-SNS-FLIGHT1 is an STM32Cube function pack, which lets your IoT node connect to a smartphone via BLE and uses a suitable Android™ or iOS™ application like the STBLESensor app to view real-time object distance data read by the Time-of- Flight sensor.

- The package also enables advanced functions, such as presence detection inside a fixed range distance.

- This package, together with the suggested combination of the STM32 and ST devices, can be used to develop wearable applications or smart thing applications in general.

- The software runs on the STM32 microcontroller and includes all the necessary drivers to recognize the devices on the STM32 Nucleo development board.

Key features

- Complete firmware to develop an IoT node with BLE connectivity, and Time-of-Flight sensors
- Compatible with STBLESensor application for Android/iOS to perform distance data reading and firmware update (FOTA)
- Multitarget ranging sensor application based on the VL53L3CX Time-of-Flight (ToF) sensor
- Sample implementation available for X-NUCLEO-53L3A2 (or VL53L3CX-SATEL) and X-NUCLEO-BNRG2A1 connected to a NUCLEO-F401RE or NUCLEO-L476RG or NUCLEO-U575ZI-Q
- Compatible with STM32CubeMX, can be downloaded from and installed directly into STM32CubeMX
- Easy portability across different MCU families, thanks to STM32Cube
- Free user-friendly license terms

Overall Software Architecture

Application	FP-SNS-FLIGHT1
Middleware	BLE BLE Manager parson
Hardware Abstraction	STM32Cube Hardware Abstraction Layer (HAL)
Hardware	STM32 Nucleo expansion boards X-NUCLEO-BNRG2A1 (Connect) X-NUCLEO-53L3A2 (Sense) VL53L3CX-SATEL (Sense)
	STM32 Nucleo development board

**Latest info available at www.st.com
FP-SNS-FLIGHT1**

2- Setup & Demo Examples

- **STSW-LINK004**
  - STM32 ST-LINK Utility (STSW-LINK004) is a full-featured software interface for programming STM32 microcontrollers

- **FP-SNS-FLIGHT1**
  - Copy the .zip file content of the firmware package into a folder on your PC.
  - The package contains source code example (Keil, IAR, STM32CubeIDE) compatible with **NUCLEO-F401RE**, **NUCLEO-L476RG, NUCLEO-U575ZI-Q**

- **ST BLE Sensor** Application for Android (V5.2.0 or higher) /iOS (V5.2.0 or higher) to download from Google Store / iTunes

2.1- Setup Overview: STM32 Nucleo with Expansion boards

Setup Overview
HW prerequisites with STM32 Nucleo Expansion boards

- 1 x Bluetooth Low Energy expansion board (**X-NUCLEO-BNRG2A1**)

- 1 x STM32 ranging sensor expansion board (**X-NUCLEO-53L3A2** or **VL53L3CX-SATEL**)

- 1 x STM32 Nucleo development board (**NUCLEO-U575ZI-Q** or **NUCLEO-F401RE** or **NUCLEO-L476RG)**

- 1x Android™ or iOS™ device

- 1 x PC with Windows 10 and above

- 1x USB type A to Mini-B USB cable for NUCLEO-F401RE or NUCLEO-L476RG

- 1x USB type A to Micro-B USB cable for NUCLEO-U575ZI-Q

NUCLEO-U575ZI-Q

NUCLEO-F401RE
NUCLEO-L476RG

X-NUCLEO-BNRG2A1

X-NUCLEO-53L3A2

VL53L3CX-SATEL

Micro USB

Mini USB
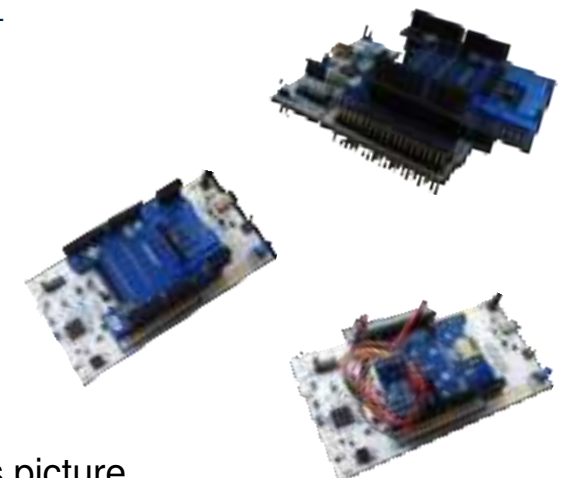
It is necessary to connect the boards in the order shown in this picture

Start coding in just a few minutes (1/3)

www.st.com/stm32ode

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FP-SNS-FLIGHT1 package structure

Name
_htmresc
Documentation	← Docs
Drivers	← BSP, HAL and drivers
Middlewares	← BlueNRG-2, BLE_Manager
Projects	← Applications and examples
STM32CubeMX
Utilities	← Boot loader binary
en.DM00251784.pdf
Package_License.html
Package_License.md
Release_Notes.html
STMicroelectronics.FP-SNS-FLIGHT1.pdsc

2

Select Function Pack:
FP-SNS-FLIGHT1

3

Download & unpack

4

.\Projects\ NUCLEO-F401RE \Examples\BootLoader
.\Projects\ NUCLEO-L476RG \ Examples \ BootLoader
.\Projects\ NUCLEO-F401RE \Applications\<53L3A2> or <CUSTOM>\FLIGHT1
.\Projects\ NUCLEO-L476RG \Applications\<53L3A2> or <CUSTOM>\ FLIGHT1
.\Projects\ NUCLEO-U575ZI-Q\Applications\<53L3A2> or <CUSTOM>\ FLIGHT1

Android™/iOS™ smartphone and
ST BLE Sensor application
(V5.2.0/5.2.0 or higher)

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Use the pre-compiled binaries for registering your device, or alternative
re-compile the code adding your device certificate

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1. How to install the pre-compiled binary:

- For each applications, there is inside the package one folder called "Binary"
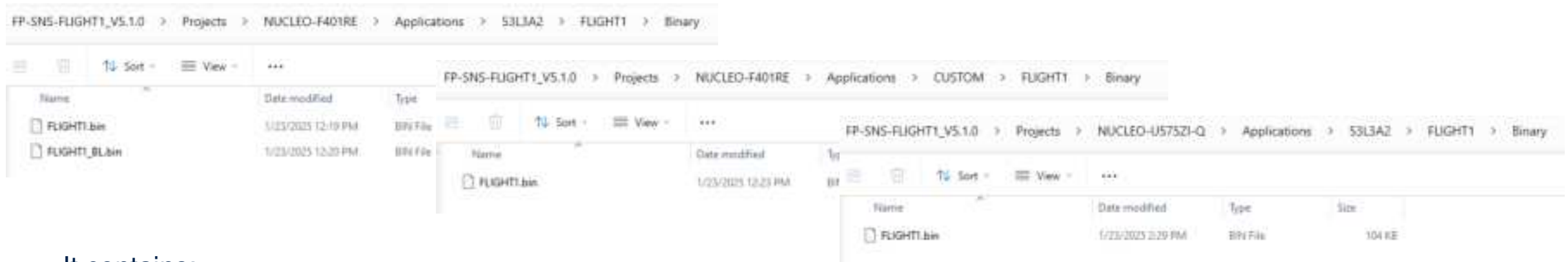
- It contains:
  - For NUCLEO-F401RE and NUCLEO-L476RG:
    - pre-compiled FP-SNS-FLIGHT1 FW that could be flashed to a supported STM32 Nucleo for X-NUCLEO-53L3A2 using the STM32CubeProgrammer at the right position (0x08004000)
      - Important Note: this pre-compiled binary is compatible with the FOTA update procedure
    - pre-compiled FP-SNS-FLIGHT1 + BootLoader FW that could be directly flashed to a supported STM32 Nucleo for X-NUCLEO-53L3A2 using the STM32CubeProgrammer or by doing "Drag & Drop"
   - Important Note: this pre-compiled binary is not compatible with the FOTA update procedure
    - pre-compiled FP-SNS-FLIGHT1 FW that could be directly flashed to a supported STM32 Nucleo for VL53L3CX-SATEL using the STM32CubeProgrammer or by doing "Drag & Drop"
  - For NUCLEO-U575ZI-Q:
    - pre-compiled FP-SNS-FLIGHT1 could be directly flashed to a supported STM32 Nucleo (for X-NUCLEO-53L3A2 and for VL53L3CX-SATEL) using the STM32CubeProgrammer or by doing "Drag & Drop".
      - Important Note: For the first installation, after the full flash erase (suggest procedure), use the STM32CubeProgrammer to set STM32 MCU user byte settings to use the bank 1 for flash the firmware and starts the application

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2. How Install the code after compiling the project for NUCLEO-F401RE and NUCLEO-L476RG:

- Compile the project with your preferred IDE

- In the folder Utilities there is a scripts *.sh that makes the following operations:
  - Full Flash Erase
  - Flash the right BootLoader at the right position (0x08000000)
  - Flash the FLIGHT1 firmware at the right position (0x08004000)
    - ➢ This is the firmware that was compiled with the IDE
    - ➢ This firmware is compatible with the FOTA update procedure
  - Save a complete Binary FW that includes both FLIGHT1 and the BootLoader
    - ➢ This binary can be directly flashed to a supported STM32 board using the ST-Link or by doing "Drag & Drop"
    - ➢ Important Note: this additional pre-compiled binary is not compatible with the FOTA update procedure

Before to execute the *.sh script, it is necessary to edit it to set the installation path for STM32CubeProgrammer.

BootLoaderPath and BinaryPath as input are required when execute *.sh script

Flash Management and Boot Process
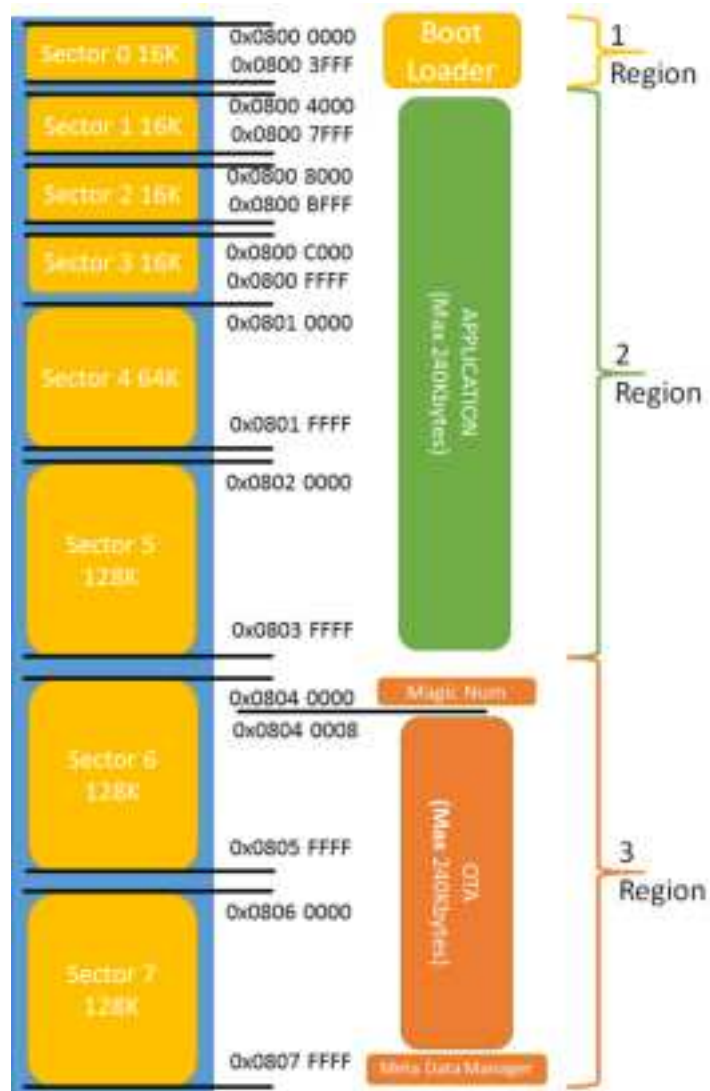
Flash Structure for STM32F401RE
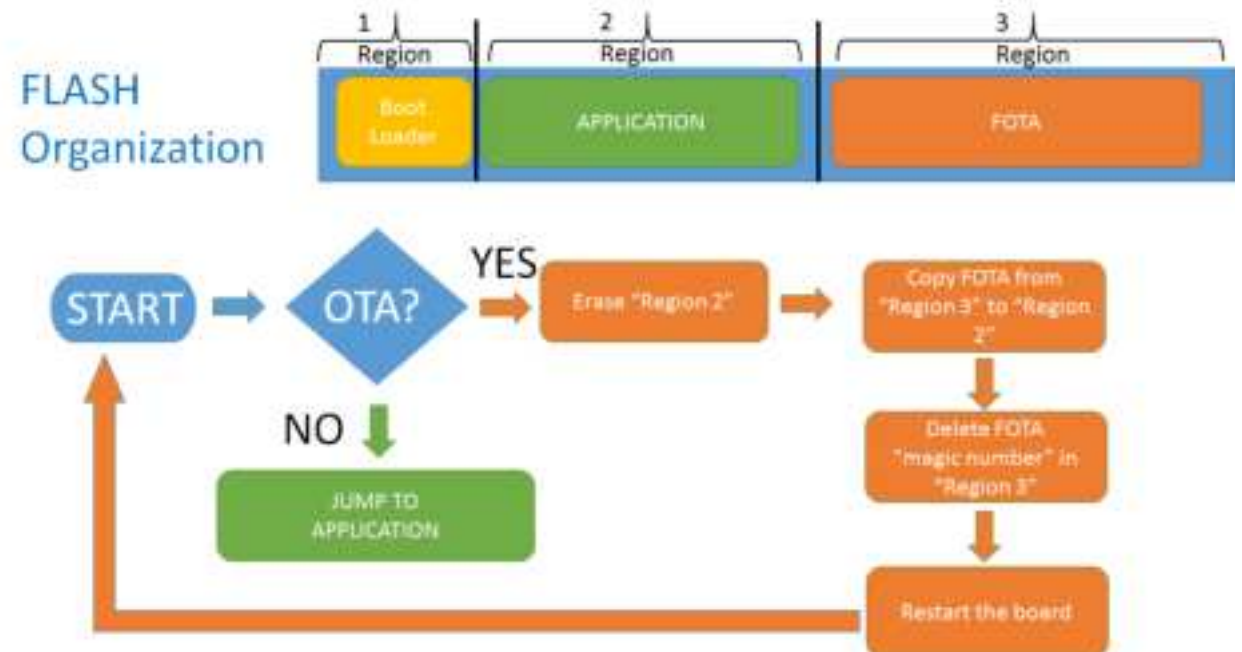
Bluetooth low energy and sensors software

FP-SNS-FLIGHT1 for NUCLEO-F401RE / NUCLEO-L476RG / NUCLEO-U575ZI-Q - Serial line monitor (e.g.Tera Term)

- Pressing the **RESET** button on STM32 Nucleo triggers the initialization phase

- When the boards are connected to an Android or iOS device, you can see what is transmitted via BLE
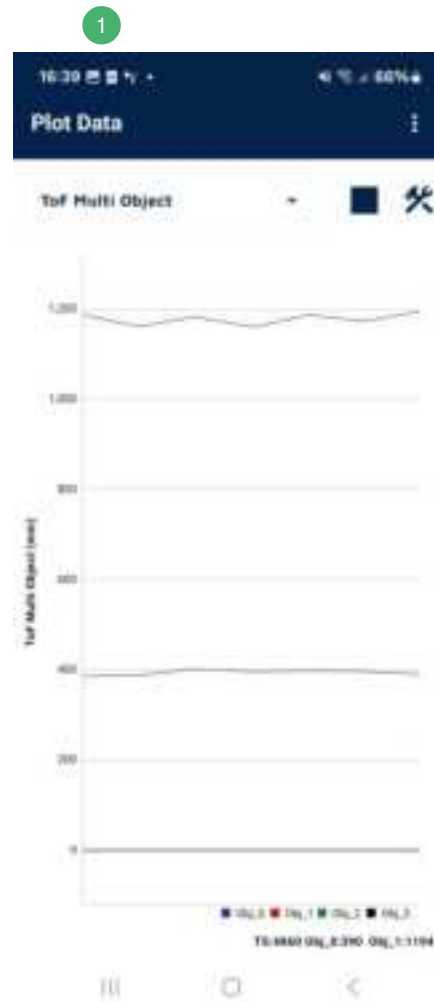
Configure the serial line monitor (speed, LF)
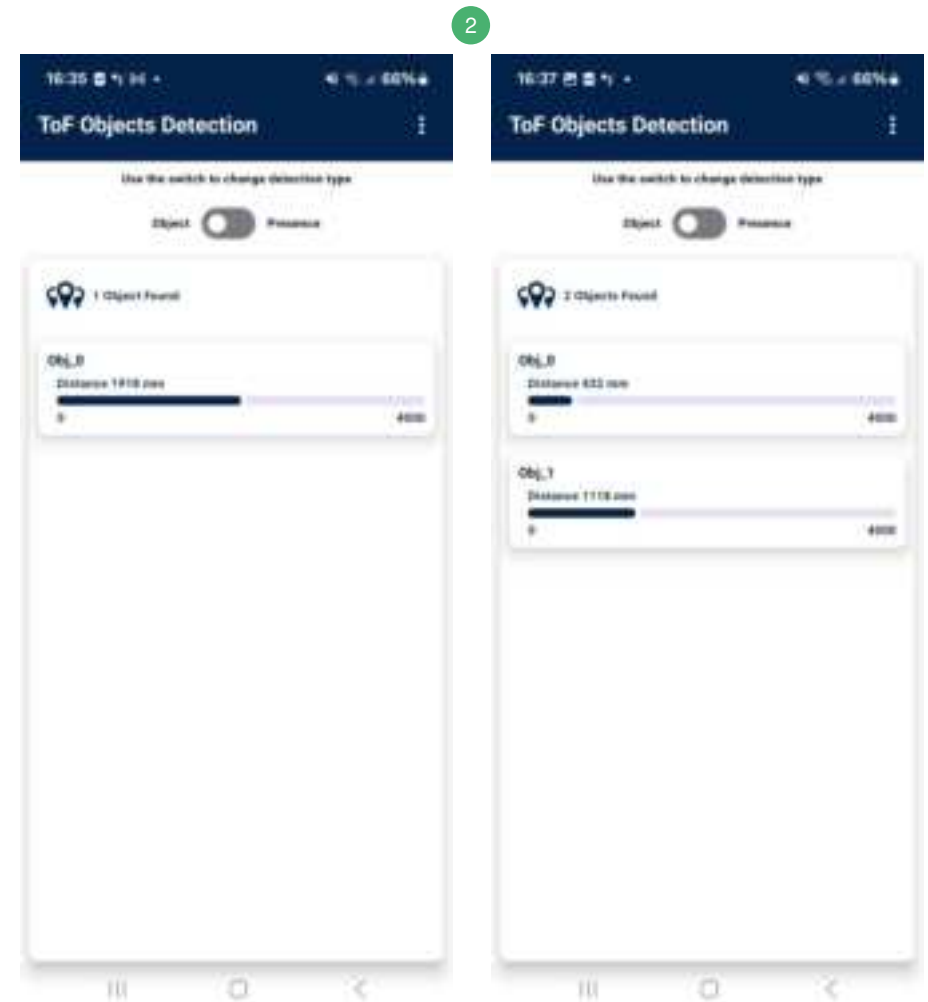
2.4- Demo Examples
ST BLE Sensor Application Overview

ST BLE Sensor Application for Android/iOS (1/5)

Hardware Features – Android Version

Plot Data: Objects distances and presence

Objects distances

ST BLE Sensor Application for Android/iOS (2/5)

Hardware Features – Android Version

Led Status

Presence Detection
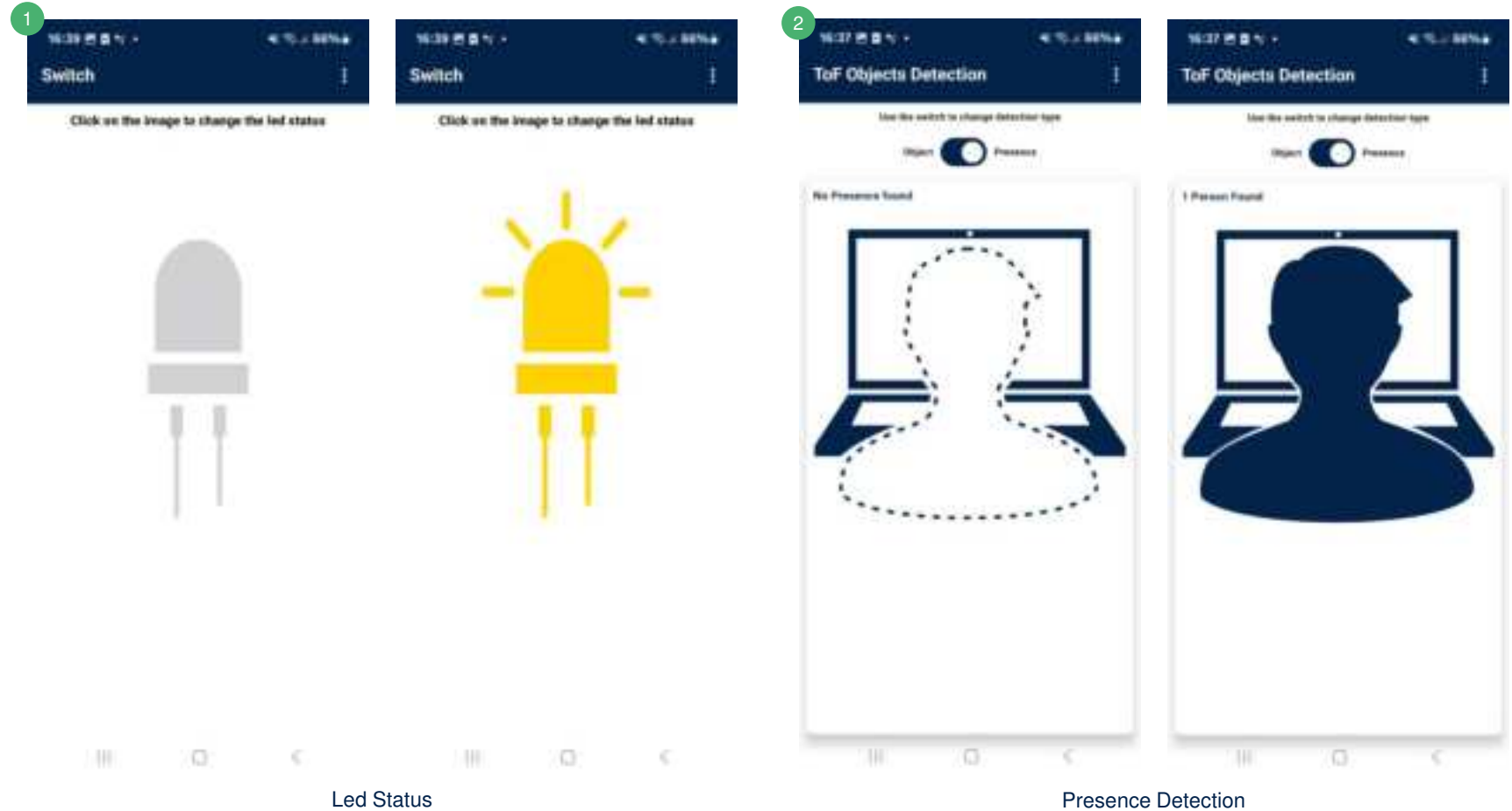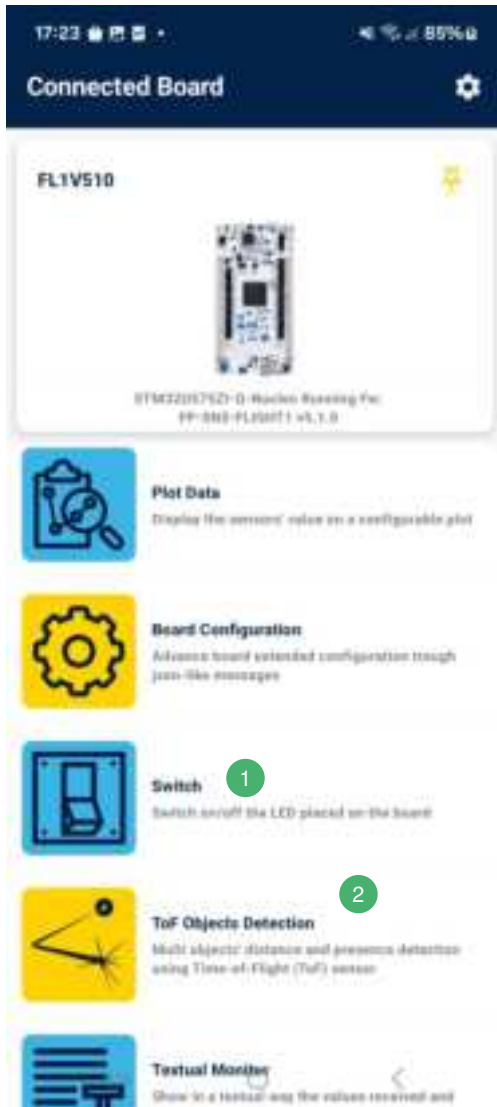
NOTE

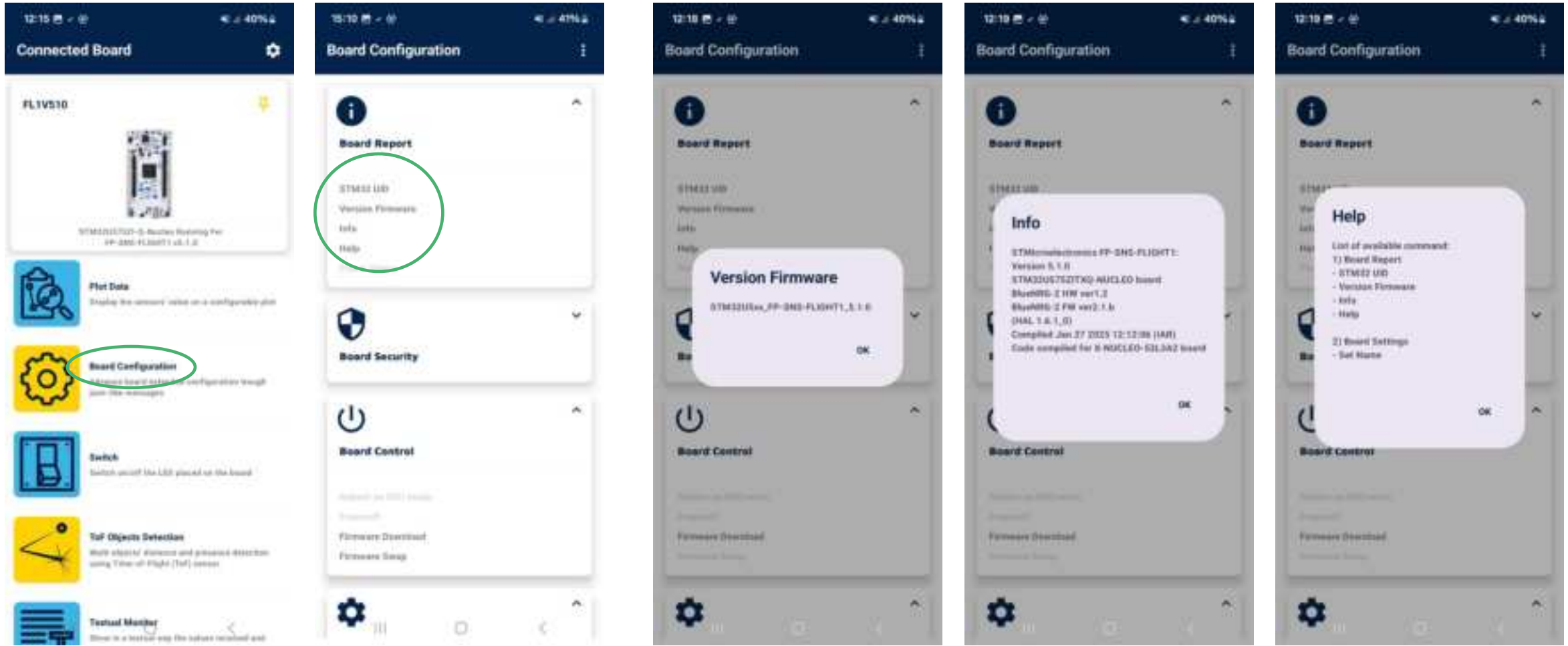The presence is identified inside a fixed range distances that can be modified by these line code:

```
#define PRESENCE_MIN_DISTANCE_RANGE 300
#define PRESENCE_MAX_DISTANCE_RANGE 800
```

in the file FLIGHT1_config.h that can find in the Inc users folder for each project.

ST BLE Sensor Application for Android/iOS (3/5)

Board Configuration – Android version

Debug Console – Android version

Menu option

Command Help

Command Info

Not Recognized Command

Firmware Upgrade – Android version

Menu option

Firmware upgrade page

Firmware update file selection

Application page during FOTA and on completion

Terminal window information during FOTA

3- Documents & Related Resources

Documents & Related Resources

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

FP-SNS-FLIGHT1:

- **DB2862**: STM32Cube function pack for IoT node with NFC, BLE connectivity and time-of-flight sensors – **data brief**
- **UM2026**: Getting started with the STM32Cube function pack for IoT node with NFC, BLE connectivity and time-of-flight sensors – **user manual**
- **Software setup file**

X-NUCLEO-BNRG2A1

- **Gerber files, BOM, Schematic**
- **DB4086:** Bluetooth Low Energy expansion board based on the BLUENRG-M2SP module for STM32 Nucleo – **data brief**
- **UM2667:** Getting started with the X-NUCLEO-BNRG2A1 BLE expansion board based on BLUENRG-M2SP module for STM32 Nucleo – **user manual**

X-NUCLEO-53L3A2:

- **Gerber files, BOM, Schematic**
- **DB4226**: Time-of-Flight ranging sensor with multi target detection expansion board based on VL53L3CX for STM32 Nucleo – **data brief**
- **UM2757:** Getting started with X-NUCLEO-53L3A2 multi target ranging ToF sensor expansion board based on VL53L3CX for STM32 Nucleo – **user manual**

VL53L3CX-SATEL:

- **Gerber files, BOM, Schematic**
- **DB4194**: VL53L3CX breakout board Time-of-Flight ranging sensor with multi target detection – **data brief**
- **UM2853:** How to use the VL53L3CX with STMicroelectronics' X-CUBE-TOF1 Time-of-Flight sensor software packages for STM32CubeMX – **user manual**
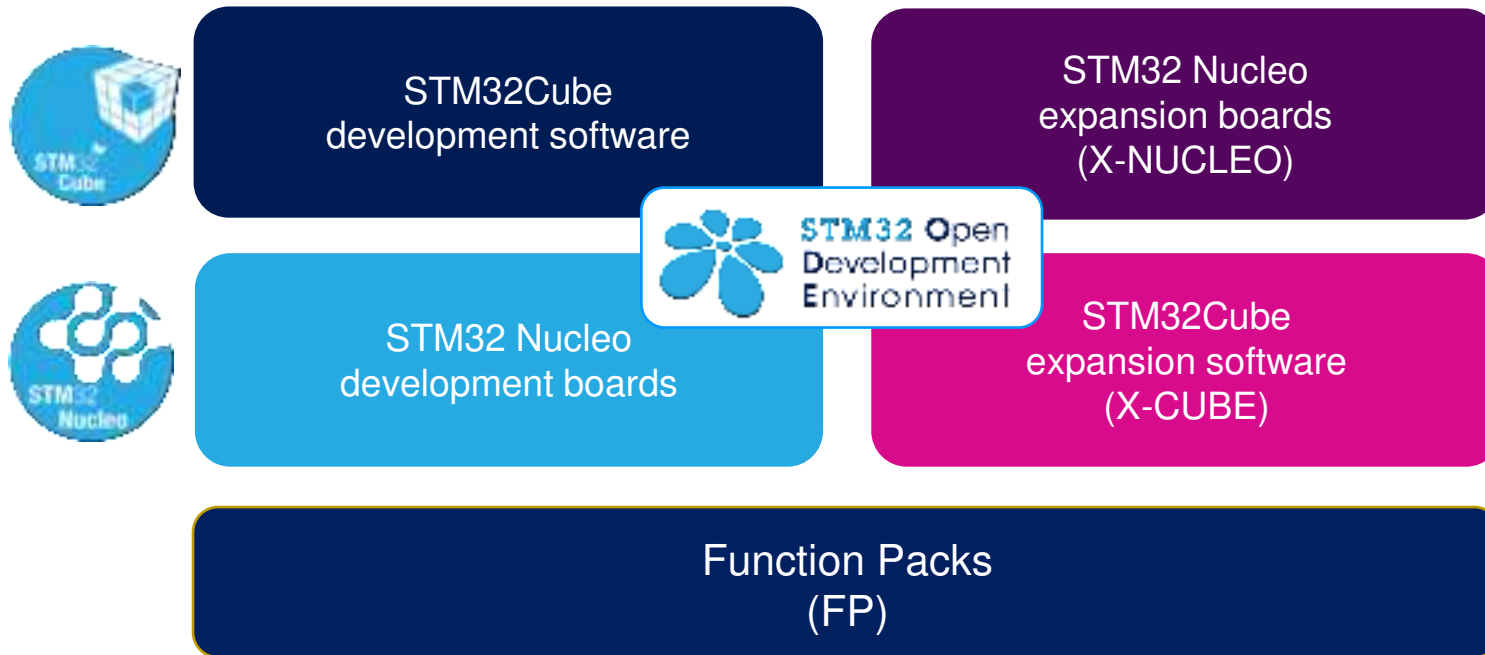
Consult www.st.com for the complete list

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)

Function Packs (FP)

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

Thank you

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