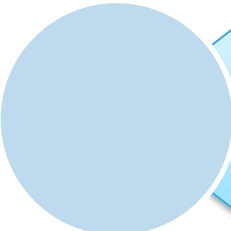# Quick Start Guide
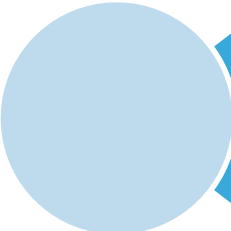
STM32Cube function pack for IoT node with BLE Mesh connectivity and Sensor Model

(FP-SNS-BLEMESH1)

life.augmented

Version 2.0 (Jul 18, 2023)

Quick Start Guide Contents

FP-SNS-BLEMESH1: STM32Cube function pack for IoT node with BLE Mesh connectivity and Sensor Model

Hardware and Software overview

Setup & Demo Examples

Documents & Related Resources

STM32 Open Development Environment: Overview

Multi-Sensors and Wireless connectivity Kit (STEVAL-MKBOXPRO)

Hardware Description

- The STEVAL-MKBOXPRO (SensorTile.box PRO) is the new ready-to-use programmable wireless box kit for developing any IoT application based on remote data gathering and evaluation, exploit the full kit potential by leveraging both motion and environmental data sensing, along with a digital microphone, and enhance the connectivity and smartness of whatever environment you find yourself into.

Key Products on board

BlueNRG-LP
On-board Bluetooth® Low Energy 5.2 (BlueNRG-LP).

MEMS Sensors
High precision sensors to gather high-quality data:
– Low-voltage local digital temperature sensor (STTS22H)
– Six-axis inertial measurement unit (LSM6DSV16X)
 – Three-axis low-power accelerometer (LIS2DU12)
– 3-axis magnetometer (LIS2MDL)
– Pressure sensor (LPS22DF)

STM32U585AI
Ultra-low-power with FPU Arm-Cortex-M33 with TrustZone® microcontroller (STM32U585AI)
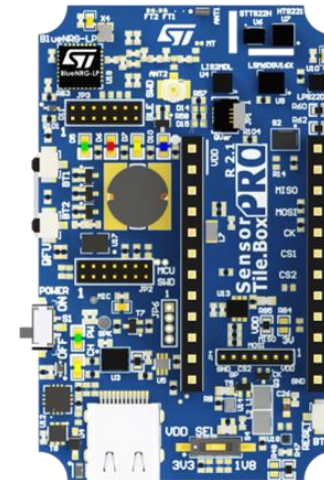
Latest info available at www.st.com
STEVAL-MKBOXPRO

Hardware Description

- The STEVAL-MKSBOX1V1 (SensorTile.box) is a ready-to-use box kit with wireless IoT and wearable sensor platform to help you use and develop apps based on remote motion and environmental sensor data, regardless of your level of expertise

Key Products on board

BlueNRG-M2
Bluetooth application processor v5.2 (BlueNRG-M2) which replaces the SPBTLE-1S Bluetooth Smart connectivity v4.2 module of the board previous batches

MEMS Sensors
– Digital temperature sensor (STTS751)
– 6-axis inertial measurement unit (LSM6DSOX)
– 3-axis accelerometers (LIS2DW12 and LIS3DHH)
– 3-axis magnetometer (LIS2MDL)
– Altimeter / pressure sensor (LPS22HH)
– Microphone / audio sensor (MP23ABS1)
– Humidity sensor (HTS221)

STM32L4R9
Ultra-low-power ARM Cortex-M4 microcontroller with DSP and FPU (STM32L4R9)

Latest info available at www.st.com
STEVAL-MKSBOX1V1

Bluetooth Low Energy Expansion Board (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-RFTR Bluetooth Low Energy module based on BlueNRG-MS.

- The BlueNRG-MS processor hosted in the SPBTLE-RFTR 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-RFTR
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

# Bluetooth Low Energy Expansion Board (X-NUCLEO-BNRG2A1)

Hardware Description

- The X-NUCLEO-BNRG2A1 expansion board provides Bluetooth low energy connectivity for developer applications and can be plugged onto an STM32 Nucleo development board (e.g., NUCLEO-L476RG with ultra-low power STM32 microcontroller) through its Arduino UNO R3 connectors.
- The expansion board features the Bluetooth® v5.0 compliant and FCC certified BlueNRG-M2SP application processor module based on the ST BlueNRG-2 System-on-Chip.

Key Products on board

BlueNRG-M2SP

The BlueNRG-M2SP module supports master and slave modes, increased transfer rates with data length extension (DLE), and AES-128 security encryption.
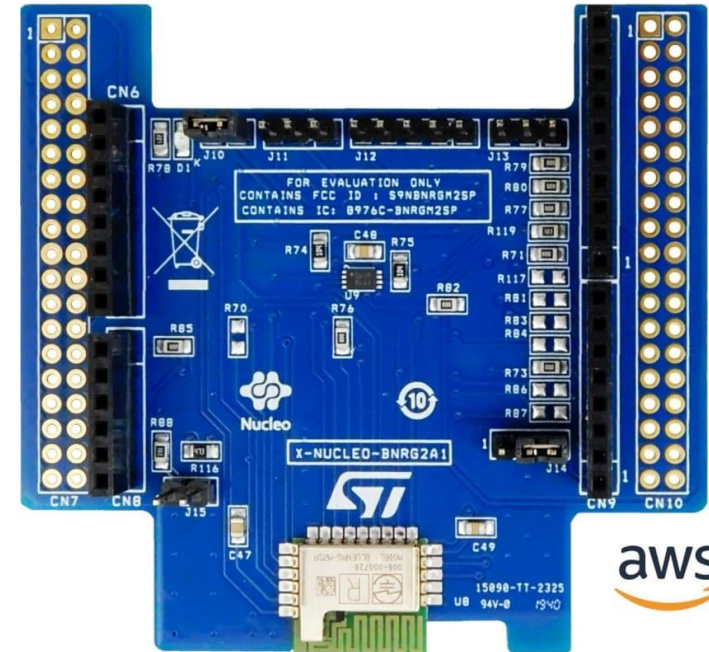
SPBTLE-RFTR

Latest info available at www.st.com
X-NUCLEO-BNRG2A1

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 Product on board

LSM6DSO
MEMS 3D accelerometer (±2/±4/±8/±16 g) + 3D gyroscope (±125/±250/±500/±1000/±2000 dps)
LIS2MDL
MEMS 3D magnetometer (±50 gauss)
LPS22HH
MEMS pressure sensor, 260-1260 hPa absolute digital output barometer
HTS221
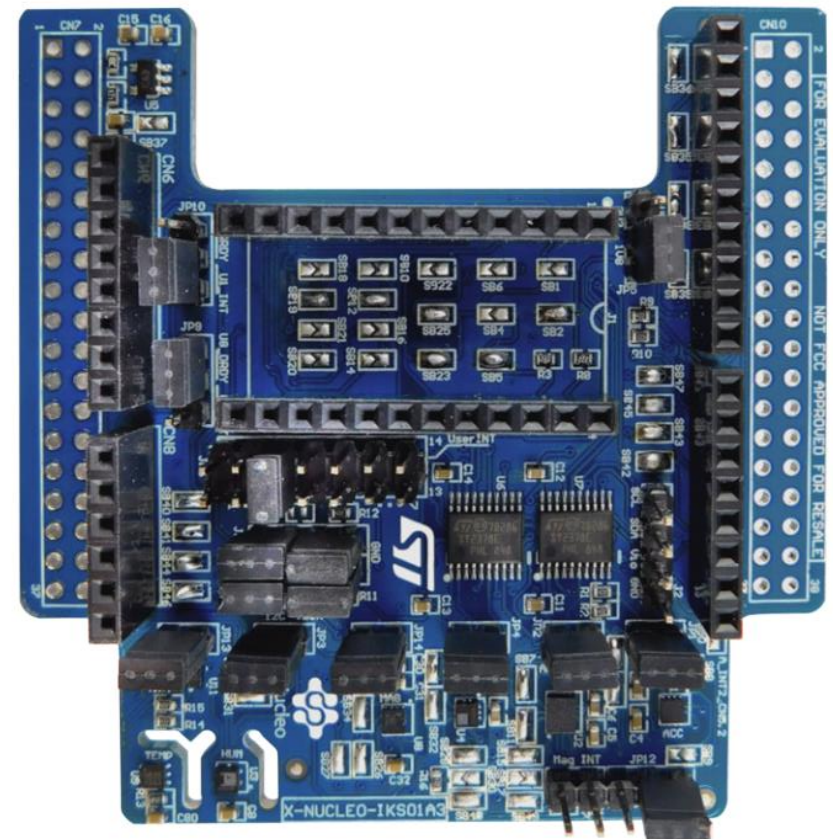**Capacitive digital relative humidity and temperature**
STTS751
Temperature sensor (–40 °C to +125 °C)
LIS2DW12
MEMS 3D accelerometer (±2/±4/±8/±16 g)
DIL 24-pin
Socket available for additional MEMS adapters and other sensors (UV index)

Latest info available at www.st.com
X-NUCLEO-IKS01A3

** Connector for the STM32 Nucleo Board

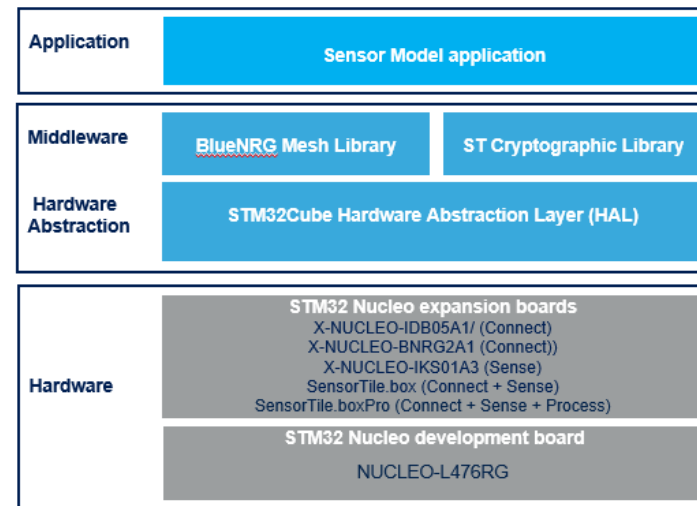# BLE Sensor Model (FP-SNS-BLEMESH1)
Software Overview

Function Pack Description

FP-SNS-BLEMESH1 is an STM32Cube function pack which lets you connect BLE nodes to a smartphone via BLE and use a suitable Android™ or iOS™ application, to view real-time environmental sensor data, motion sensor data using BLE mesh sensor model.
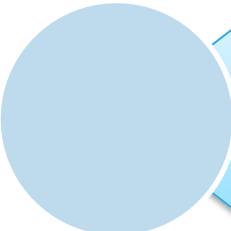
Key features

- Complete software to build Mesh network with Bluetooth low energy (BLE) nodes supporting the "BLE Mesh Sensor Model", defined in BLE Mesh Specification V1.0

- Transmission of environmental and motion sensor data to proxy node using the "Sensor Model".

- User can see sensors value on hyper terminal or on a mobile application, such as the companion BlueNRG-Mesh app available for Android/iOS

- Sample implementation available on X-NUCLEO-IDB05A1/X-NUCLEO-BNRG2A1 board and X-NUCLEO- IKS01A3 connected to a NUCLEO-L476RG development board. SensorTile.box and SensorTile.boxPro eval boards support as well.

- Easy portability across different MCU families, thanks to STM32Cube

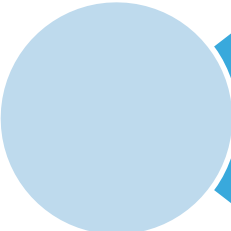- Free, user-friendly license terms

Overall Software Architecture

Application	Sensor Model application

Middleware	BlueNRG Mesh Library	ST Cryptographic Library
Hardware Abstraction	STM32Cube Hardware Abstraction Layer (HAL)	

Hardware	**STM32 Nucleo expansion boards** X-NUCLEO-IDB05A1/ (Connect) X-NUCLEO-BNRG2A1 (Connect)) X-NUCLEO-IKS01A3 (Sense) SensorTile.box (Connect + Sense) SensorTile.boxPro (Connect + Sense + Process)
	STM32 Nucleo development board NUCLEO-L476RG

Latest info available at www.st.com

FP-SNS-BLEMESH1

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STM32 Open Development Environment: Overview

- 1x SensorTile.box Board **(STEVAL-MKSBOX1V1)**
- 1x SensorTile.boxPro Board **(STEVAL-MKBOXPRO)**
- 1x Motion MEMS and environmental sensor expansion board (**X-NUCLEO-IKS01A3**)
- 1x Bluetooth Low Energy Expansion Board (**X-NUCLEO-IDB05A1/X-NUCLEO-BNRG2A1**)
- STM32 Nucleo development board **NUCLEO-L476RG**
- 1x BLE-enabled Android™ device
- Laptop/PC with Windows 7, 8 or 10

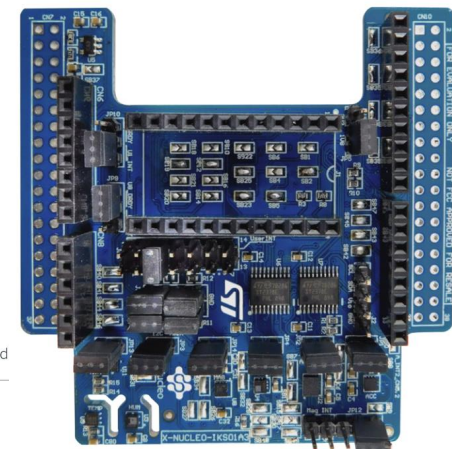- 1x USB type A to Mini-B USB cable
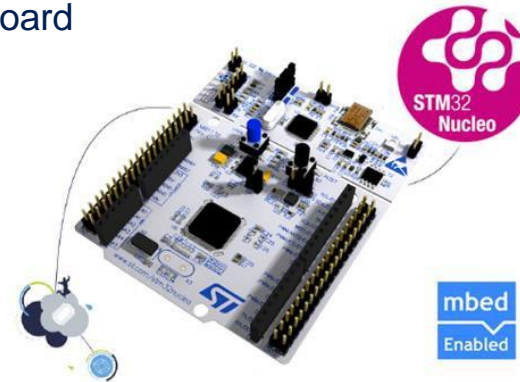
NUCLEO-L476RG

Mini USB Cable

X-NUCLEO-IDB05A1
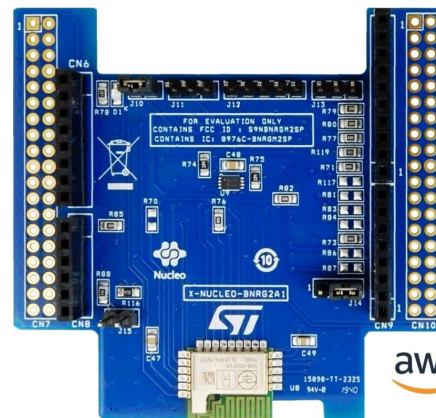
X-NUCLEO-BNRG2A1

X-NUCLEO-IKS01A3

- FP-SNS-BLEMESH1 package
  - Download and extract the **FP-SNS-BLEMESH1** package, version 1.5.0

- A toolchain to build the firmware
  - The FP-SNS-BLEMESH1 has been developed and tested with
    - IAR Embedded Workbench for ARM® (EWARM) toolchain + ST-Link
    - RealView Microcontroller Development Kit (MDK-ARM) toolchain + ST-LINK
    - System Workbench for STM32 (SW4STM32) + ST-LINK (*)

- BlueNRG-Mesh App, available for iOS ([Link](#)) and Android ([Link](#))

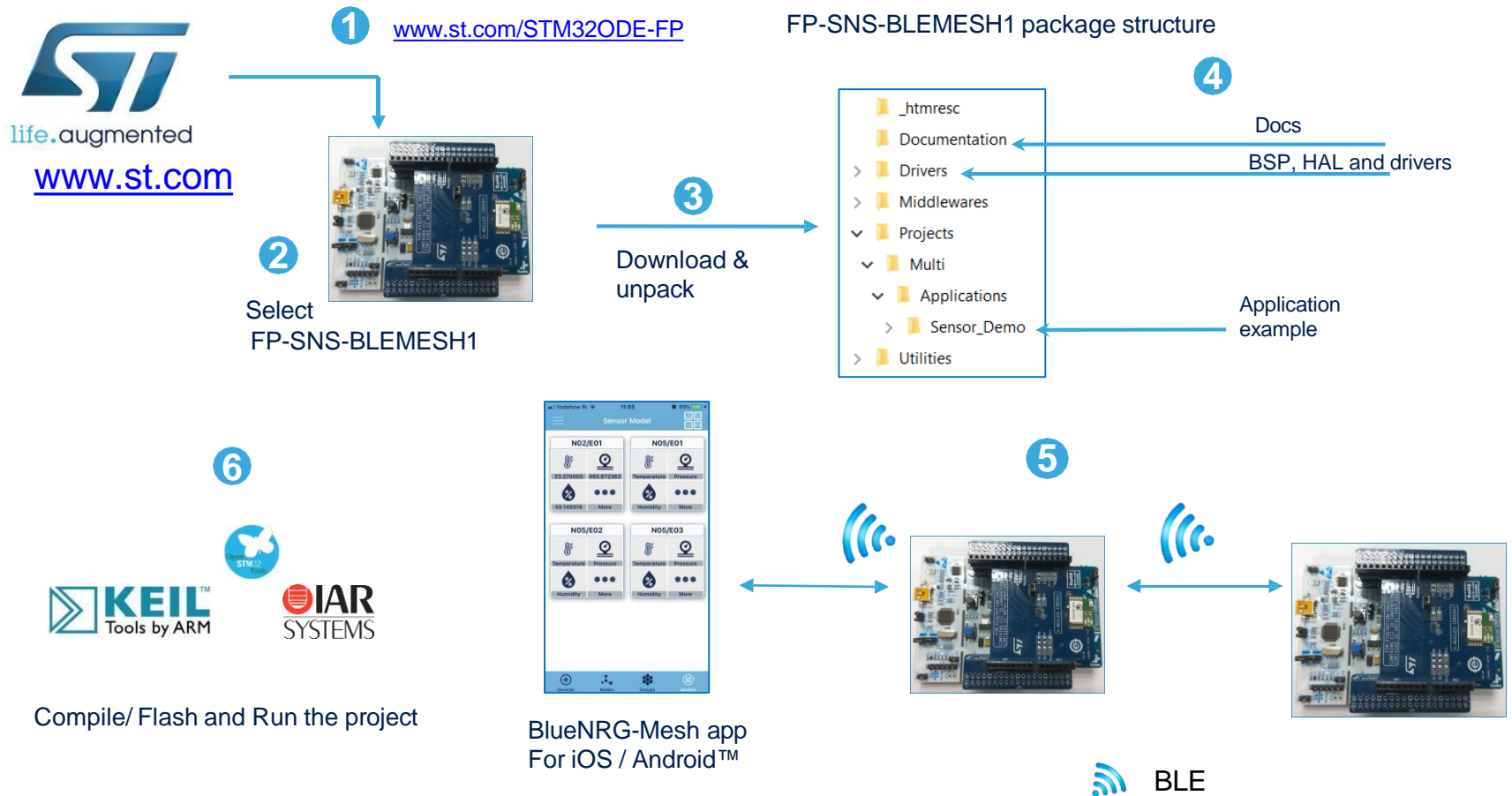- Serial line monitor e.g. Termite (Windows), or Minicom (Linux)

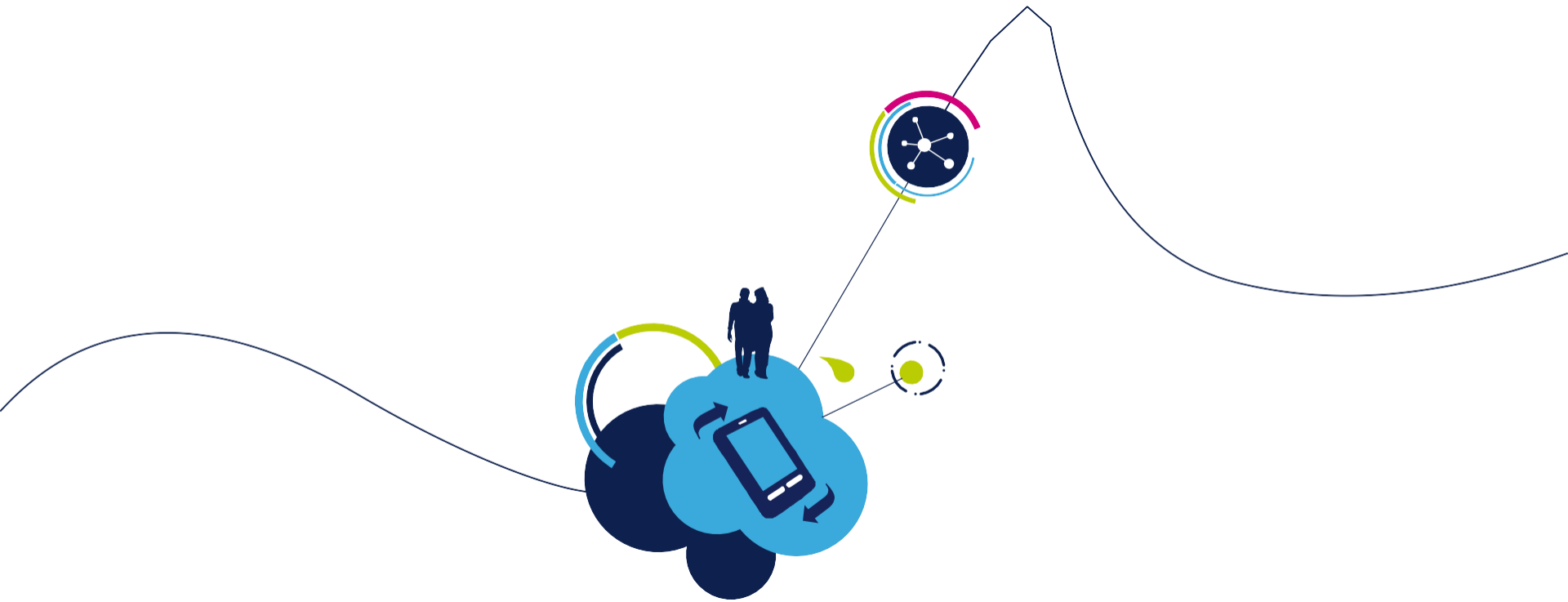(*) For Linux users: System Workbench for STM32 (SW4STM32) is the only supported IDE
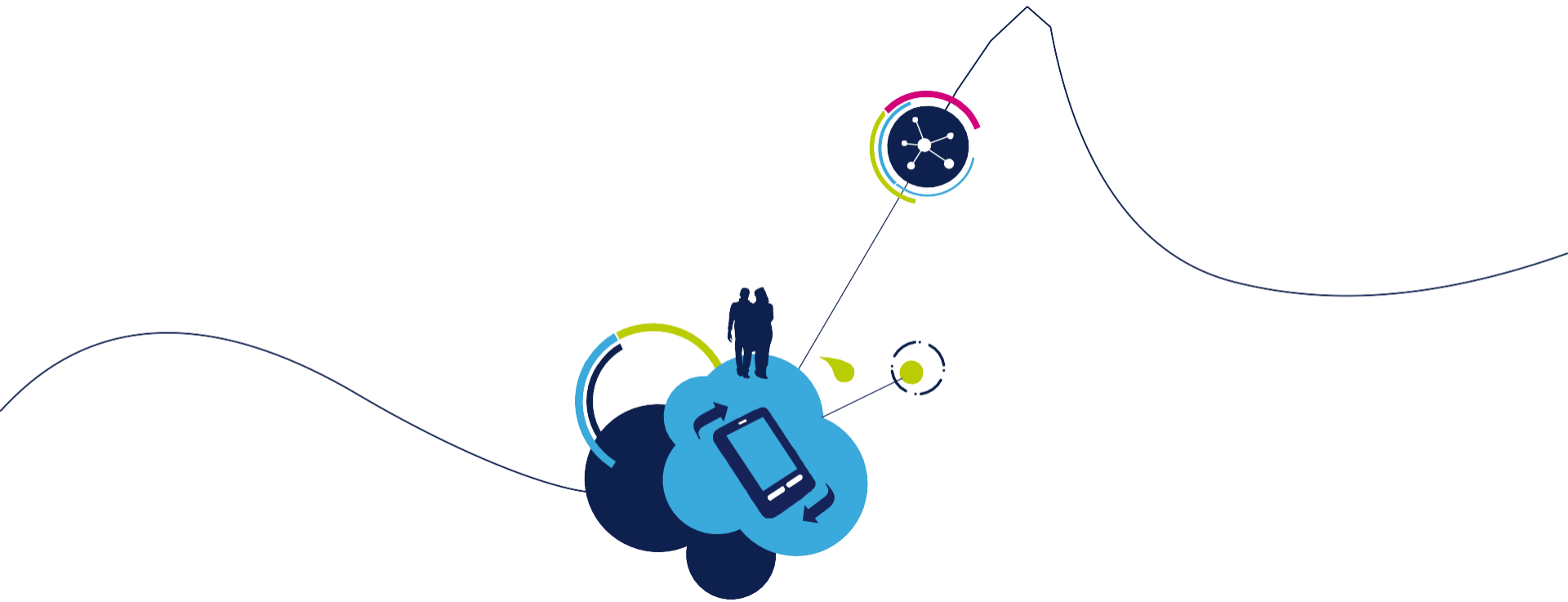
Sensor Model - Demo Execution
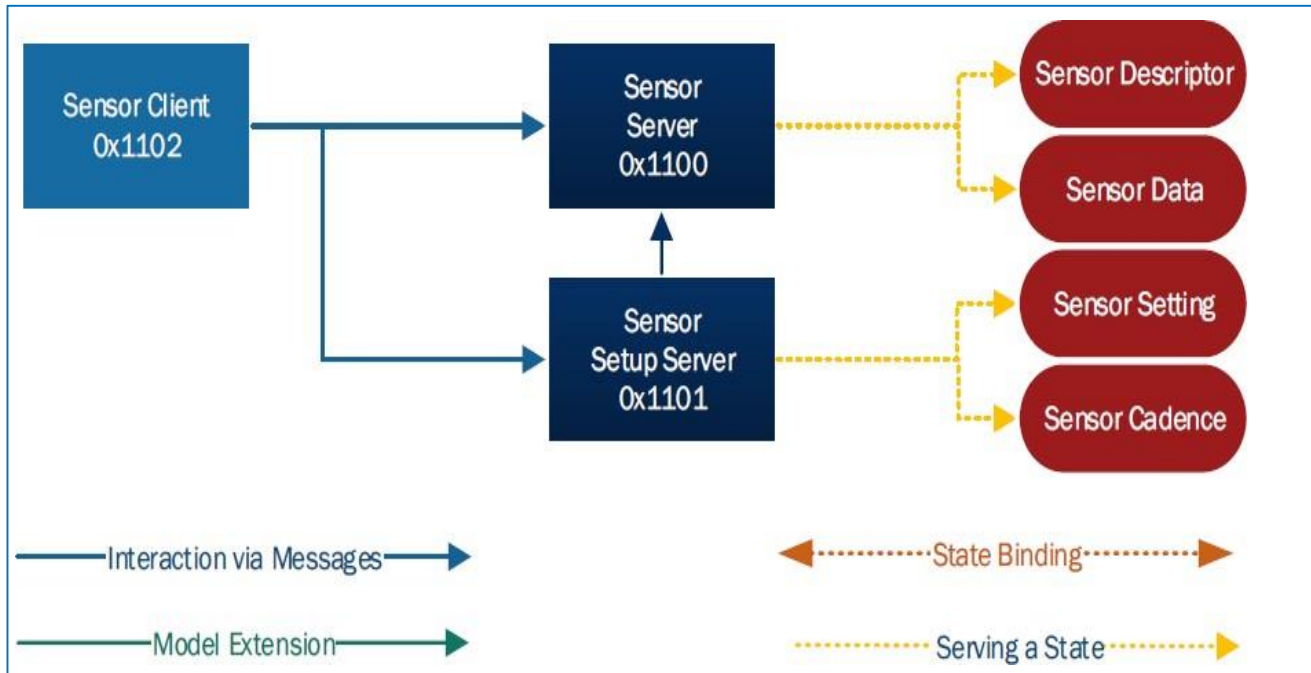
Sensor PID Values

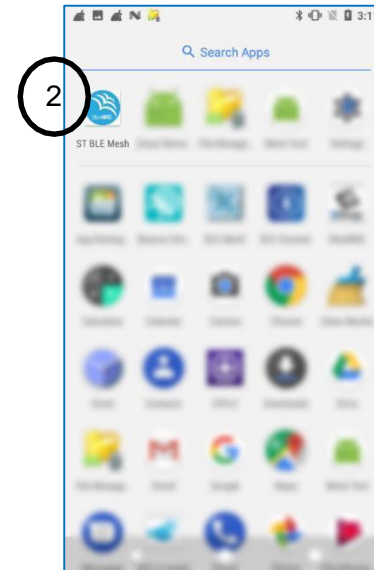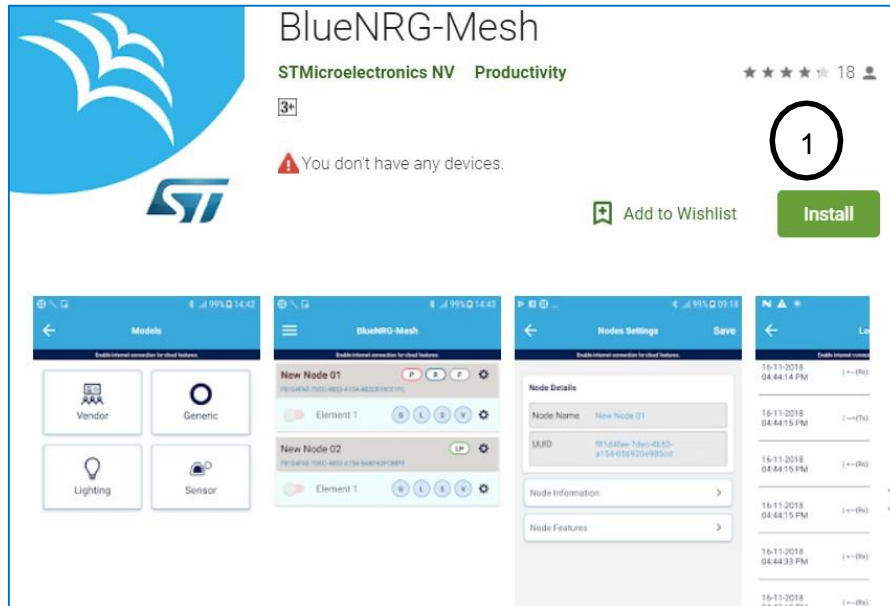| Sensor Name	Property ID
TEMPERATURE_PID	0x0071
PRESSURE_PID	0x2A6D
HUMIDITY_PID	0x2A6F
MAGNETO_METER_PID	0x2AA1
ACCELERO_METER_PID	0x2BA1
GYROSCOPE_PID	0x2BA2

BLE Mesh connectivity and Sensor Model software

① www.st.com/STM32ODE-FP

FP-SNS-BLEMESH1 package structure

www.st.com

④

② Select FP-SNS-BLEMESH1

③ Download & unpack

- _htmresc
- Documentation ← Docs
- Drivers ← BSP, HAL and drivers
- Middlewares
- Projects
  - Multi
    - Applications
      - Sensor_Demo ← Application example
- Utilities

⑤

⑥

Compile/ Flash and Run the project

BlueNRG-Mesh app
For iOS / Android™

BLE

Sensor Demo Using Android Application

Download and Install the BlueNRG-Mesh Android App

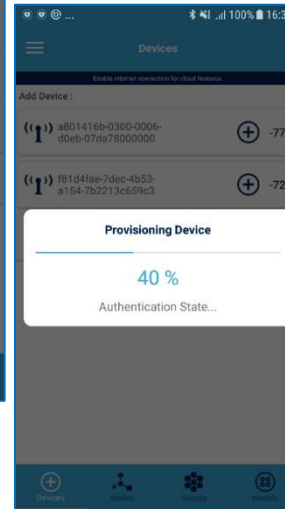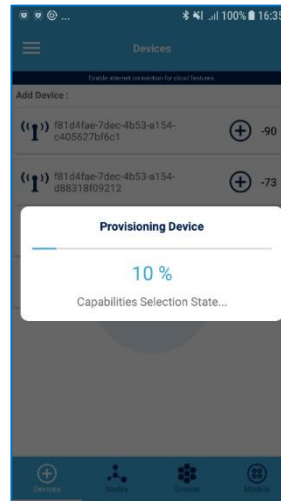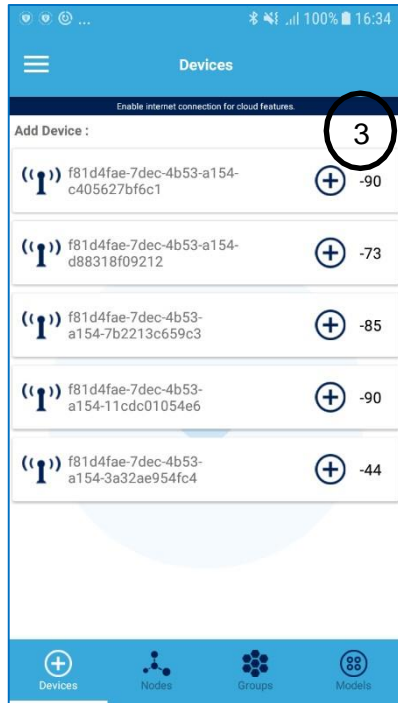https://play.google.com/store/apps/details?id=com.st.bluenrgmesh&hl=en

Please note the updated Sensor App will be available soon on the store.
The Current App from the store does not yet support extended sensors
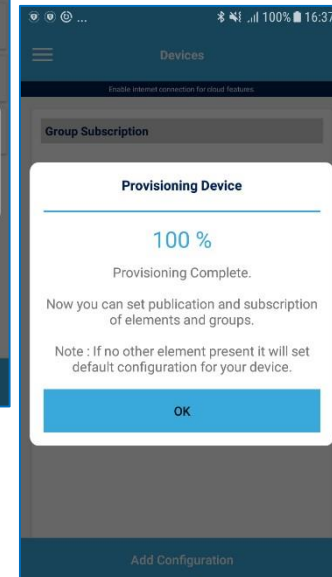
Provision the Sensor Device by clicling +
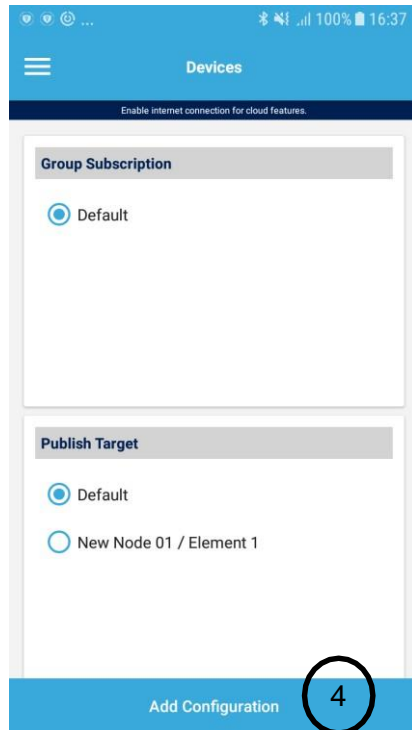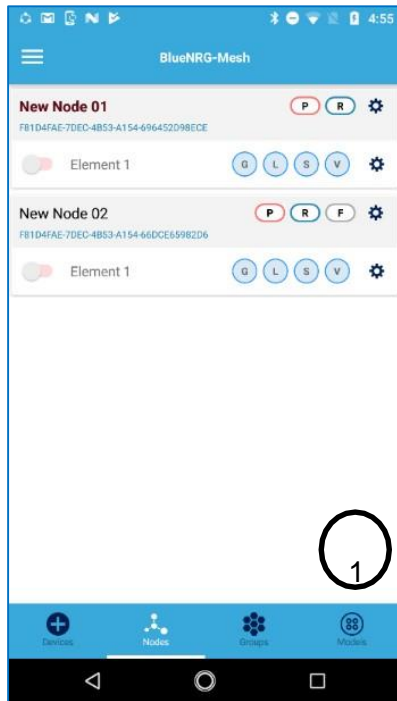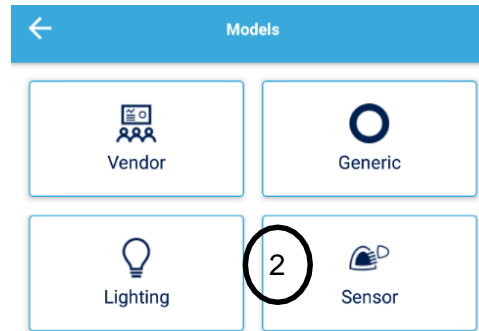
Add Configuration

Click 'S' to view
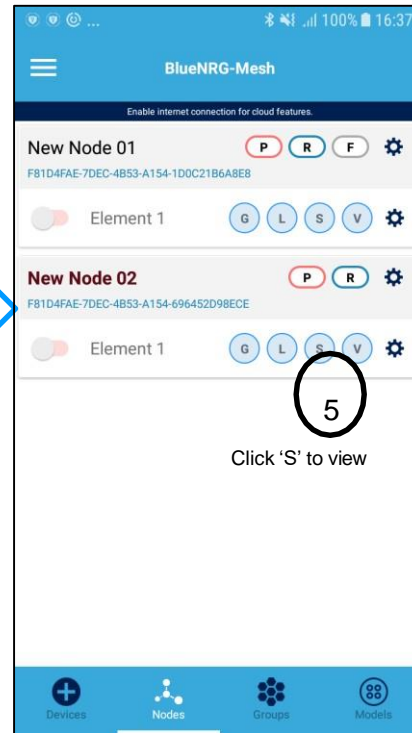
Device Provisioned
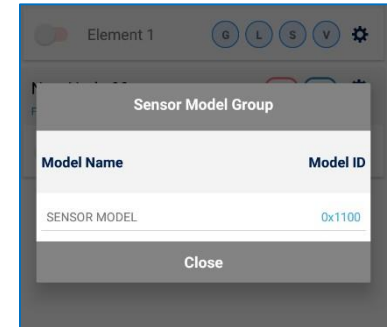
Sensor Model(Compact View)

Click Model TAB

Click 'refresh' to get all sensor data
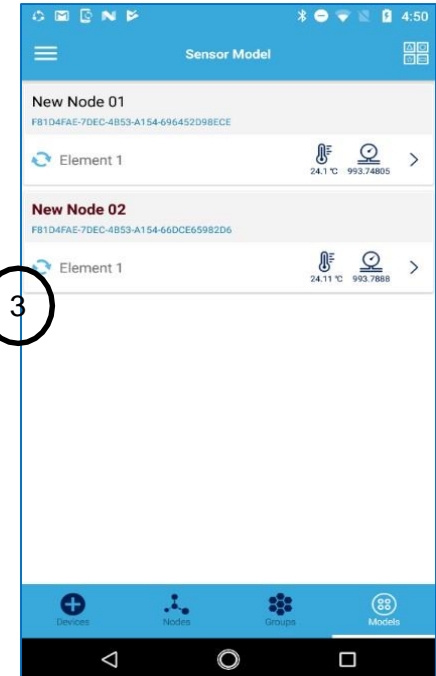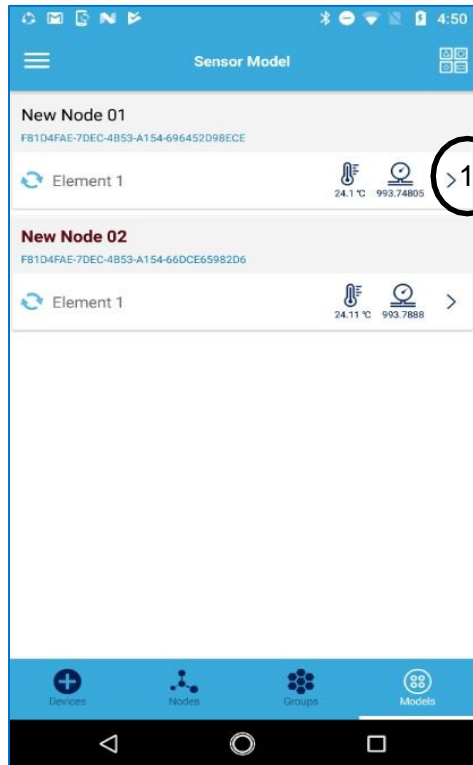
Get All Sensors view

Click each icon to get respective sensor value
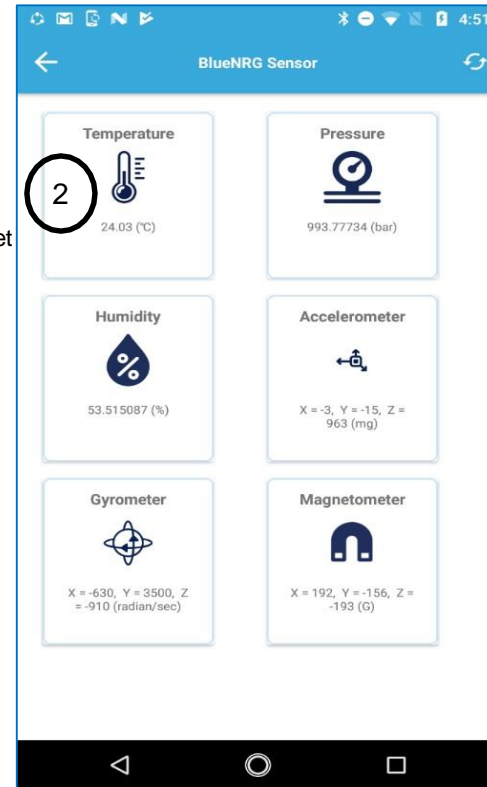
Click icon to get All sensors values
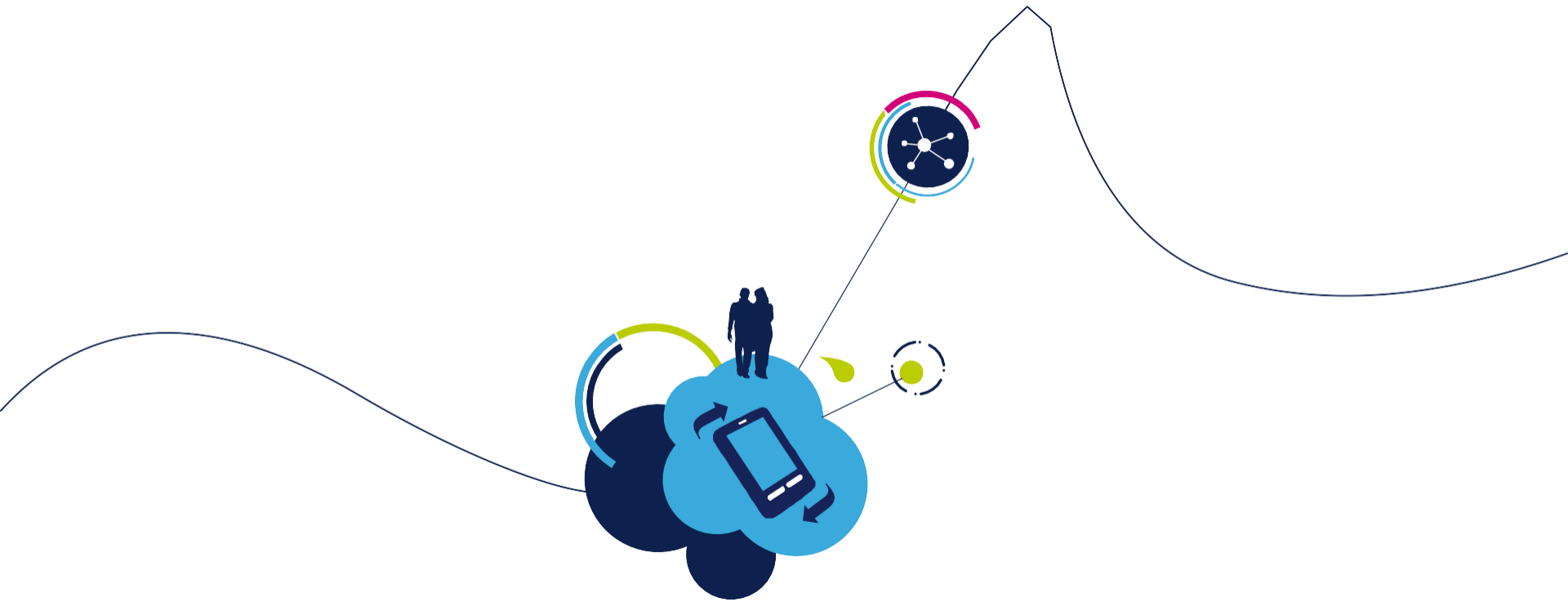
Sensor Demo Using iOS Application

Follow the instructions below to install BNRG-Mesh app on a

compatible iOS device.

Step 1. Follow the link to Apple Store at STSW-BNRG-Mesh to

download the app directly to your iOS device or search for

BlueNRG-Mesh app.

Step 2. Ensure that Bluetooth radio is enabled.

Step 3. Launch the app by clicking on the icon.

Step 4. If Bluetooth is off or not supported, you are presented with a

dialog box that prompts you to enable Bluetooth on your

device. At this stage, you can either:
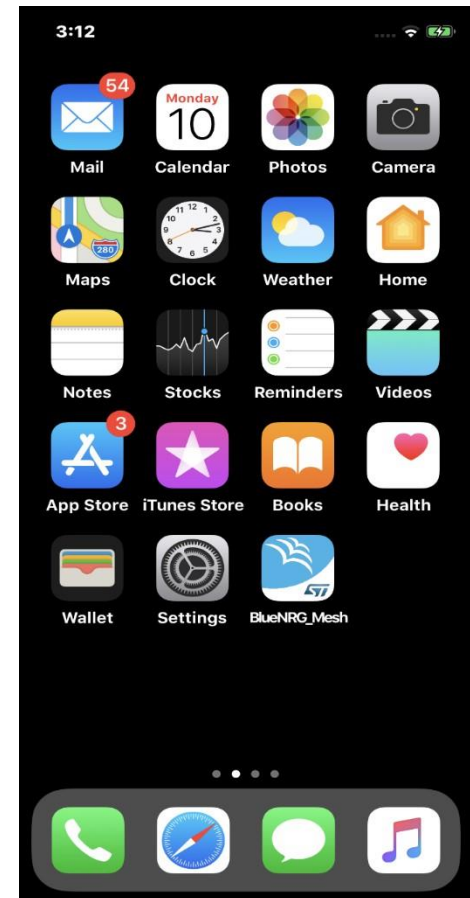
The App has following sections:

1) **Nodes Tab:** opens the "Network View", which shows the list of all the nodes in the mesh network. This is the default view (that is, the home page) of the App.

2) **Device Tabs:** Opens the "Provisioning View" which allows adding new provisioned mesh capable devices into the mesh network.

3) **Groups Tab:** opens the "Groups View", which shows the list of all the groups in the network.

4) **Models Tab:** opens the "Model View", which shows the list of nodes supporting the selected model. It allows sending specific messages to the nodes.

5) **Side Menu:** contains global settings, which affects the App as a whole.
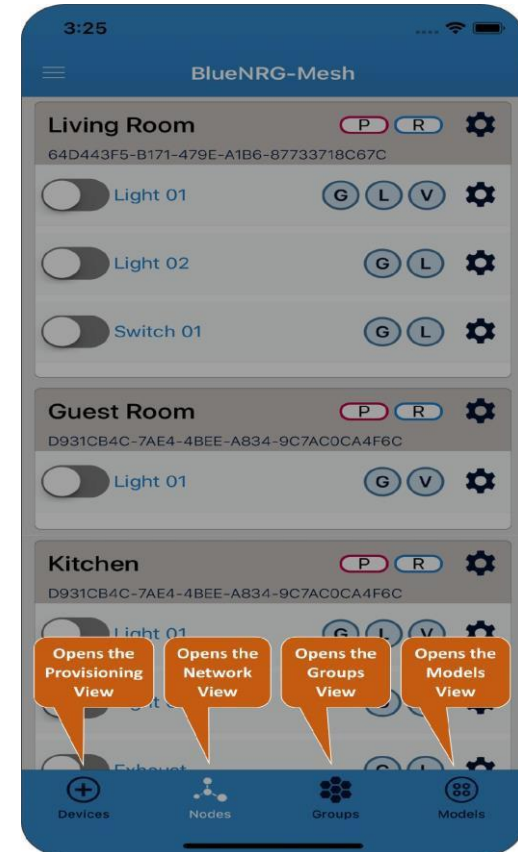
- When devices view opened, the App starts scanning for unprovisioned mesh capable devices in the proximity.

- The devices are identified by their UUIDs and are listed with RSSI values.

- The provisioning process will get started by clicking on the (+) icon in front of each device name.
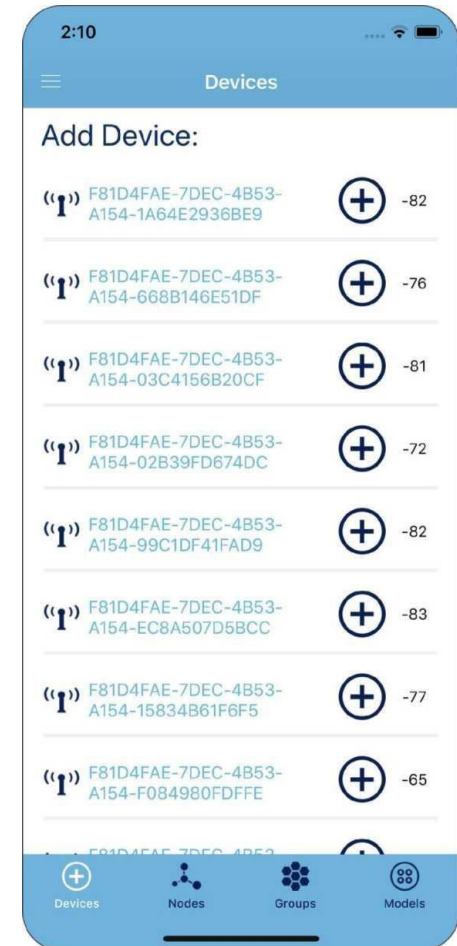
- This is the default view of the BlueNRG-Mesh iOS app, which shows the overall network status with a summary of the node type and features.

- All provisioned node will be presented in this nodes tab.

- User can also view or update the node settings or configuration.

- Each node element has a toggle button used to send on/off commands, which can be "Vendor Model" or "Generic Model" depending on the global settings (accessible from the side menu).
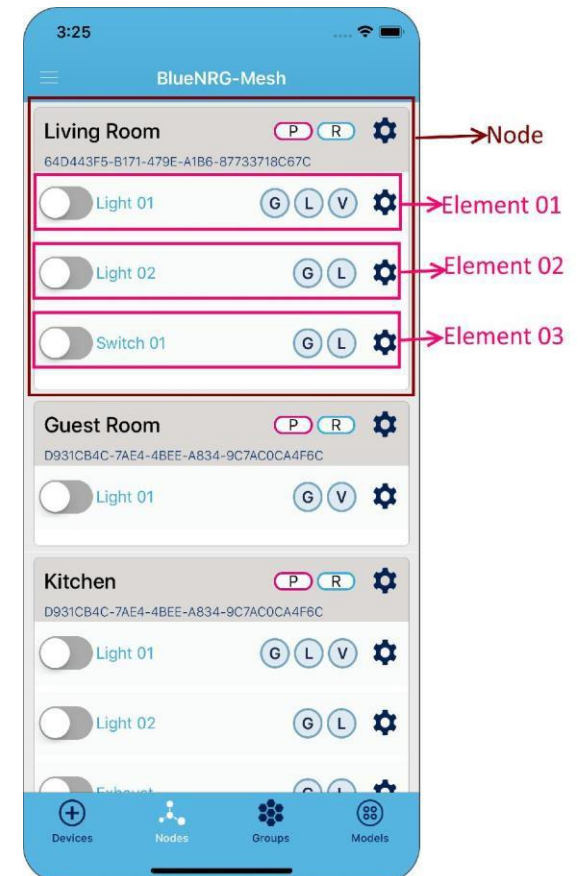
- Models view allows users to access a model specific functionality.

- When the Models Tab is tapped for the first time, it opens the "Model Selection View" to choose a specific model.

- Once the selected model view will appear. The app will remember that selected model, so that, the next time you select the Models Tab, the last chosen model view will open up.

- You can switch the model view to any other model by tapping the "Model Selection" icon at the top right of each model view.
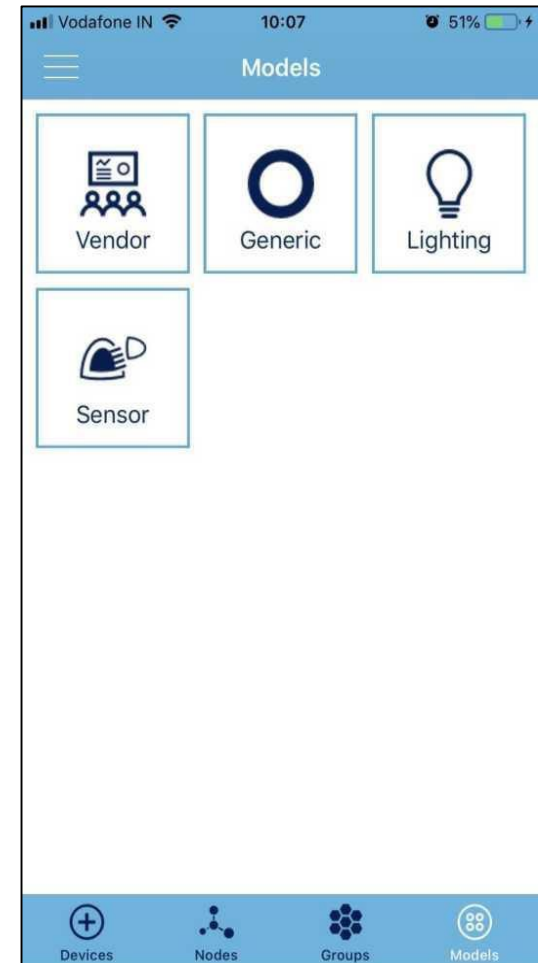
- After selecting the sensor model from the model selection view, this view will be representing all the sensor nodes.

- Each sensor node itself containing the four further division, first three among them representing the sensors and the last one will open the detailed sensor model view.

- Detailed sensor view will advocate all the available sensors of the sensor node with their respective values.

- On upper right extreme, there is an icon to open the model selection view.

- Detailed sensor view will show all the available sensors, with their respective values.

- On click of each sensor, it will update that sensor value only i.e in our case, First is Temperature sensor, on click of temperature sensor, current temperature value will be updated.

- Refresh icon on the extreme right corner of the screen will refresh the sensor values of all the sensors.

NOTE: If a node is not active to receive or send the protocols to communicate, it will show "Sensor Data not available" beneath each sensor icon.

Documents & Related Resources

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

FP-SNS-BLEMESH1:

- **DB3817:** STM32Cube function pack for IoT node with BLE Mesh Connectivity and Sensor Model – **data brief**
- **UM2536:** Getting started with FP-SNS-BLEMESH1 function pack for IoT node with BLE Mesh connectivity and Sensor Model – **user manual**
- **UM2180**: Getting started with the ST BlueNRG-Mesh Android application
- Software setup file

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-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**

STEVAL-MKBOXPRO

- Gerber files, BOM, Schematic
- **DB4590**: SensorTile.box PRO with multi-sensors and wireless connectivity for any intelligent IoT node
- **UM3133**: Getting started with SensorTile.box PRO multi-sensors and wireless connectivity development kit for any intelligent IoT node
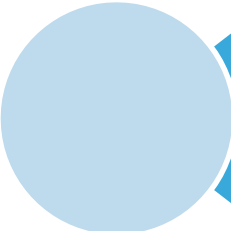
STEVAL-MKSBOX1V1

- Gerber files, BOM, Schematic
- **DB3903**: SensorTile.box with multi-sensors and wireless connectivity for any intelligent IoT node
- **UM2580**: How to use the wireless multi-sensor development kit with customizable app for IoT and wearable sensor applications

Consult www.st.com for the complete list

Quick Start Guide Contents

FP-SNS-BLEMESH1: STM32Cube function pack for IoT node with BLE Mesh connectivity and Sensor Model

Hardware and Software overview

Setup & Demo Examples

Documents & Related Resources

STM32 Open Development Environment: Overview

STM32 Open Development Environment
Fast, affordable Prototyping and Development

- The STM32 Open Development Environment (ODE) consists of a set of stackable boards and a modular open SW environment designed around the STM32 microcontroller family.
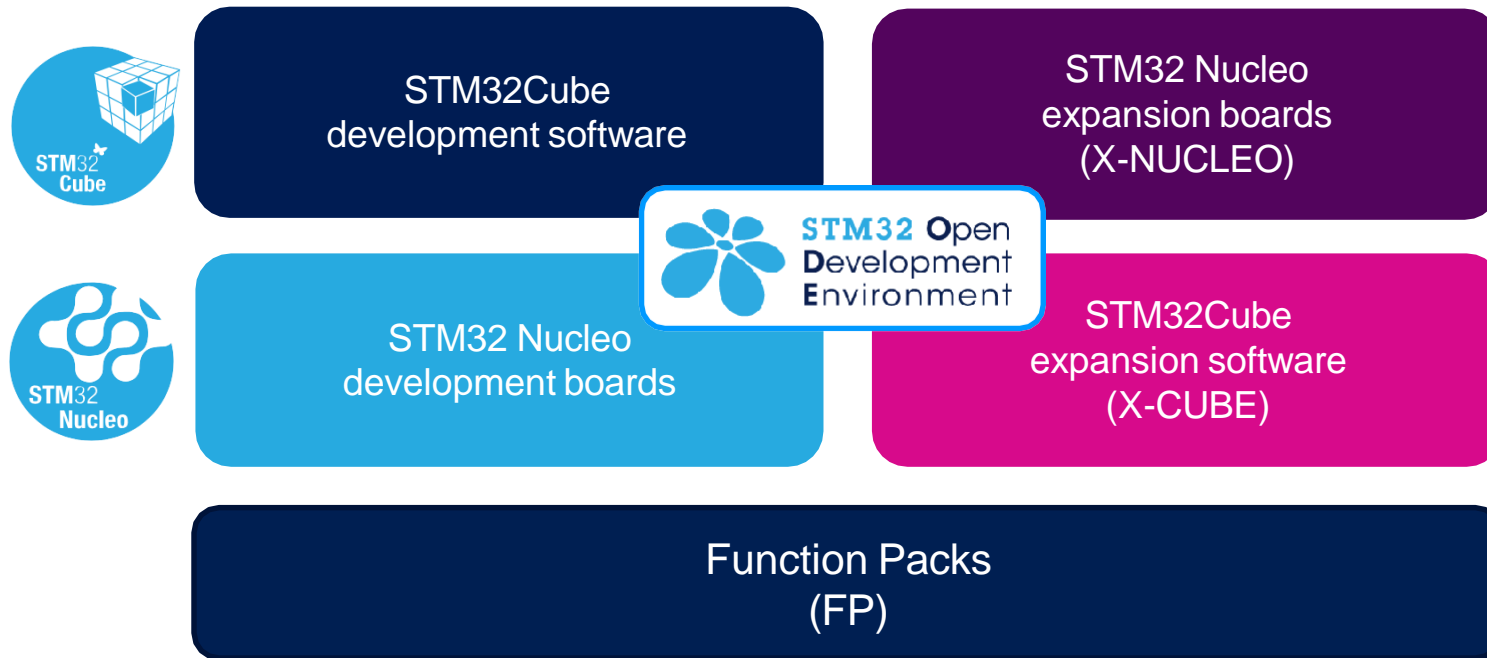
www.st.com/stm32ode

- A comprehensive range of affordable development boards for all the STM32 microcontroller series, with unlimited unified expansion capabilities and integrated debugger/programmer functionality.

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
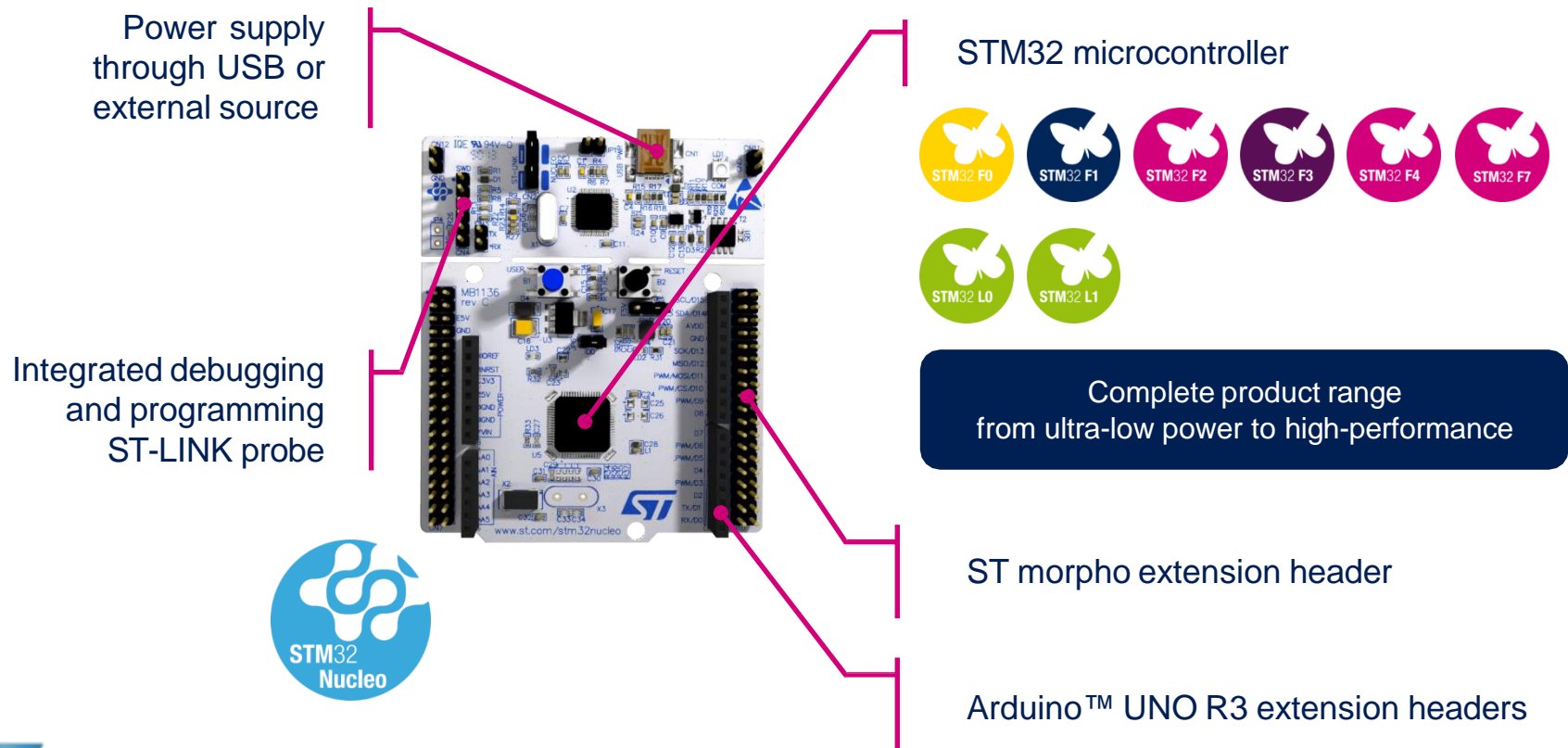
- Boards with additional functionality that can be plugged directly on top of the STM32 Nucleo development board directly or stacked on another expansion board.

Connect

Power

Move/Actuate

Interact

Sense

Motion MEMS sensors

Environmental sensors

DIL24 support for new devices
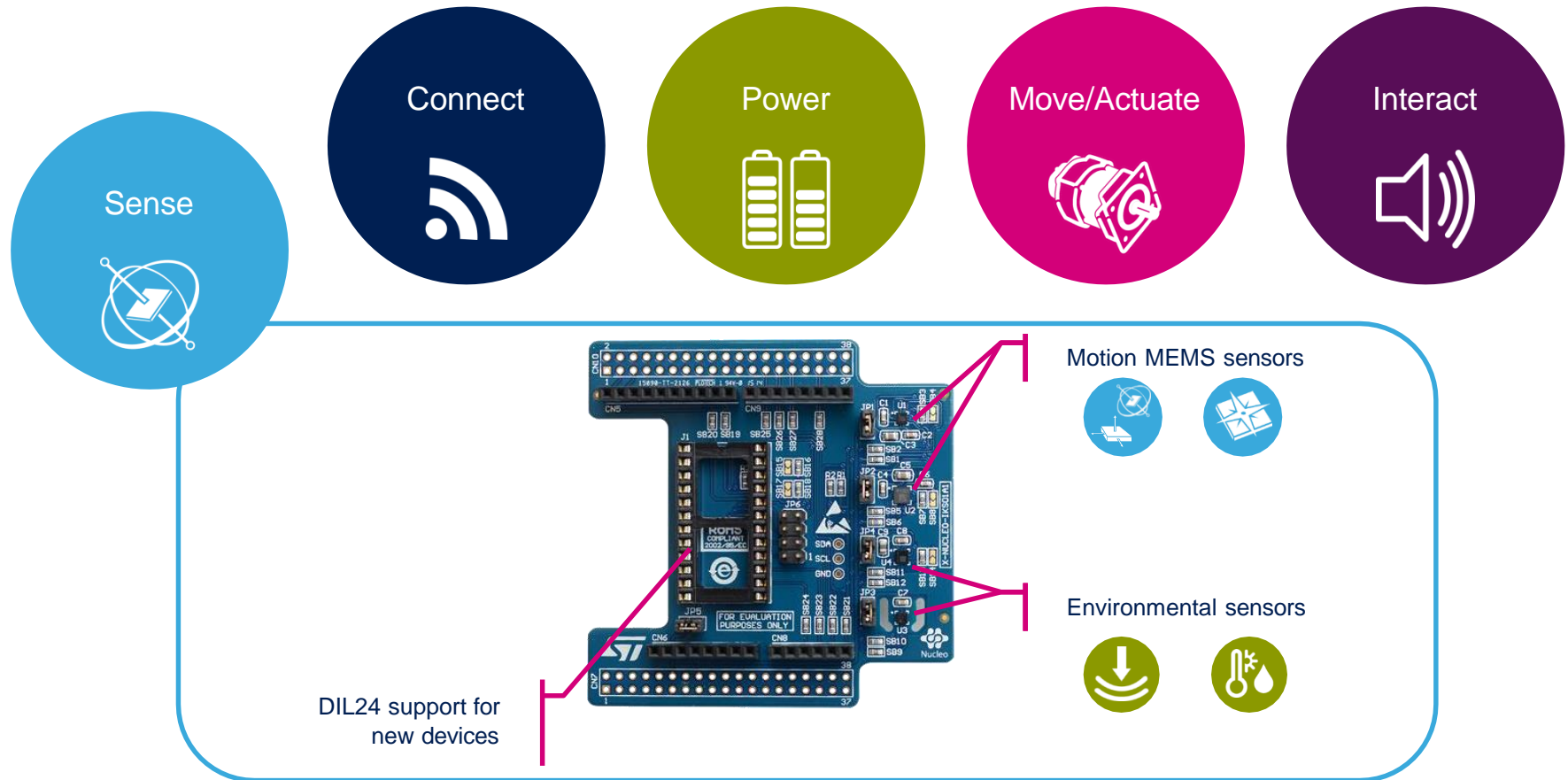
Example of STM32 expansion board (X-NUCLEO-IKS01A1)

- **STM32Cube software (CUBE)** - A set of free tools and embedded software bricks to enable fast and easy development on the STM32, including a Hardware Abstraction Layer and middleware bricks.

- **STM32Cube expansion software (X-CUBE)** - Expansion software provided free for use with the STM32 Nucleo expansion board and fully compatible with the STM32Cube software framework. It provides abstracted access to expansion board functionality through high-level APIs and sample applications.
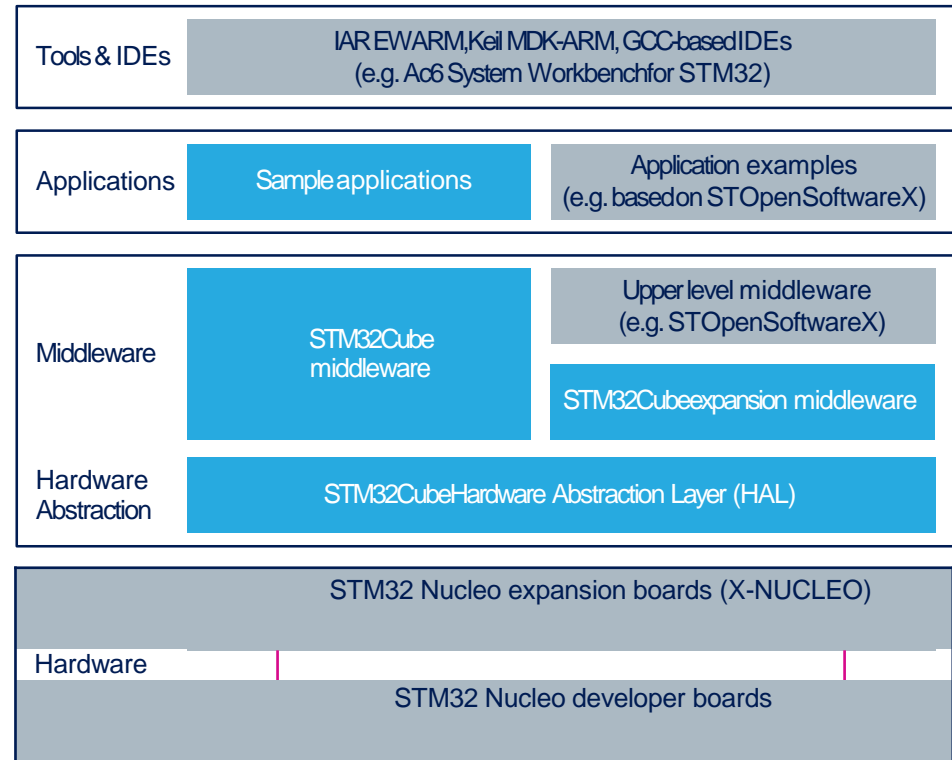
Tools & IDEs	IAR EWARM, Keil MDK-ARM, GCC-based IDEs (e.g. Ac6 System Workbench for STM32)	
Applications	Sample applications	Application examples (e.g. based on STOpenSoftwareX)
Middleware	STM32Cube middleware	Upper level middleware (e.g. STOpenSoftwareX)
		STM32Cube expansion middleware
Hardware Abstraction	STM32Cube Hardware Abstraction Layer (HAL)	
Hardware	STM32 Nucleo expansion boards (X-NUCLEO)	
	STM32 Nucleo developer boards	

- **Compatibility with multiple Development Environments -** The STM32 Open Development Environment is compatible with a number of IDEs including IAR EWARM, Keil MDK, and GCC-based environments. Users can choose from three IDEs from leading vendors, which are free of charge and deployed in close cooperation with ST. These include Eclipse-based IDEs such as Ac6 System Workbench for STM32 and the MDK-ARM environment.
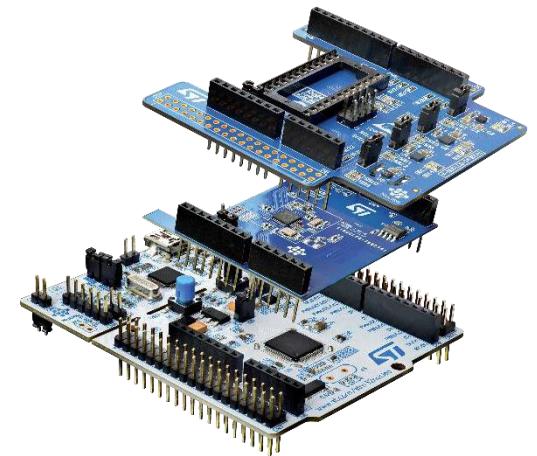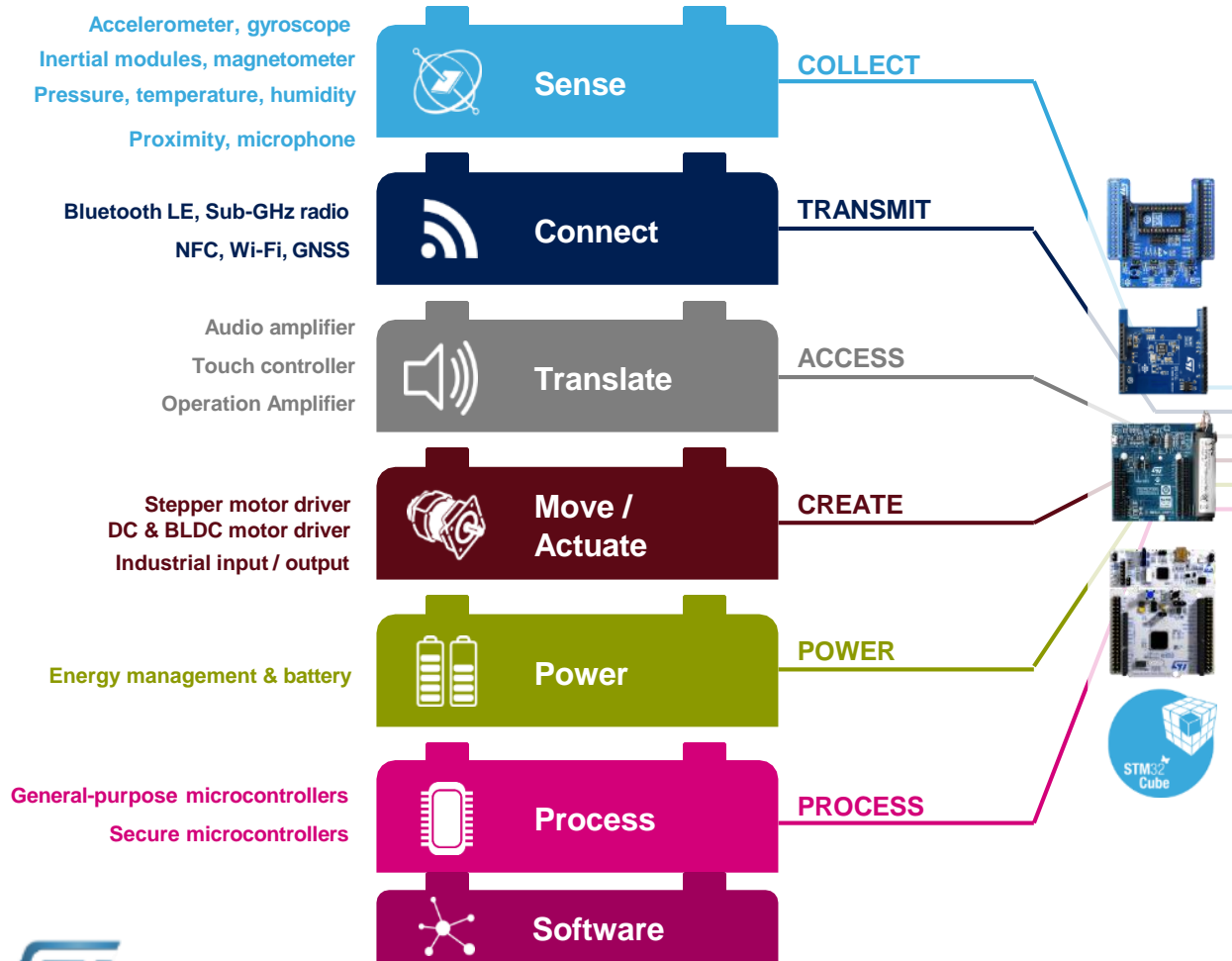
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The building blocks → Your need → Our answer

Sense — COLLECT
- Accelerometer, gyroscope
- Inertial modules, magnetometer
- Pressure, temperature, humidity
- Proximity, microphone

Connect — TRANSMIT
- Bluetooth LE, Sub-GHz radio
- NFC, Wi-Fi, GNSS

Translate — ACCESS
- Audio amplifier
- Touch controller
- Operation Amplifier

Move / Actuate — CREATE
- Stepper motor driver
- DC & BLDC motor driver
- Industrial input / output

Power — POWER
- Energy management & battery

Process — PROCESS
- General-purpose microcontrollers
- Secure microcontrollers

Software

STM32 Open Development Environment

STM32 Cube

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