Quick Start Guide

STM32 ODE function pack for IoT node with BLE connectivity, digital microphone, environmental and motion sensors (FP-SNS-ALLMEMS1)
Quick Start Guide Contents

FP-SNS-ALLMEMS1: STM32 ODE function pack for IoT node with BLE connectivity, digital microphone, environmental and motion sensors

Hardware and Software overview

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STM32 Open Development Environment: Overview
X-NUCLEO-IKS01A1 Hardware Description

- The X-NUCLEO-IKS01A1 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

**LSM6DS0**: MEMS 3D accelerometer (±2/±4/±8 g) + 3D gyroscope (±245/±500/±2000 dps)

**LIS3MDL**: MEMS 3D magnetometer (±4/±8/±12/±16 gauss)

**LPS25HB**: 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)

**Latest info available at www.st.com**

X-NUCLEO-IKS01A1
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)
X-NUCLEO-IKS01A1 Key Features

- The X-NUCLEO-IKS01A1 is a motion MEMS and environmental sensor evaluation board system.
- All sensor sensors are connected on a single I²C bus
- Sensor I²C address selection
- Each sensor has separate power supply lines allowing power consumption measurement
- Sensor disconnection (disconnect the I²C bus as well as the power supply)
- Interrupt and DRDY signals from sensors
- DIL24 socket (Compatible to STEVAL-MKI***V* MEMS adapter boards)

* is used as a wildcard character for related part number
X-NUCLEO-IDB04A1 Hardware Description

- The X-NUCLEO-IDB04A1 is a Bluetooth Low Energy (BLE) evaluation and development board system, designed around ST’s BlueNRG BLE network processor.

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

Key Products on board

**BlueNRG**
ST Bluetooth® Low Energy wireless network processor, BLE4.0 compliant

**BALF-NRG-01D3**
50 Ω nominal input / conjugate match balun to BlueNRG transceiver, with integrated harmonic filter, insuring matching and filtering

Latest info available at www.st.com X-NUCLEO-IDB04A1
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 through an SPI link available on the Arduino UNO R3 connector.

Key Products on board

**SPBTLE-RF**

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
X-NUCLEO-CCA02M1 Hardware Description

- The X-NUCLEO-CCA02M1 is a board based on digital MEMS microphones. It has two MP34DT01-M microphones soldered on board and it offers the possibility to plug additional microphones using MP34DT01 based coupon evaluation boards (STEVAL-MKI129V* or STEVAL-MKI155V*).
- The X-NUCLEO-CCA02M1 enables the acquisition and streaming of up 4 microphones using both I²S and SPI bus available on ST morpho connector.

Key Products on board

**MP34DT01-M:** Ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface.

* is used as a wildcard character for related part number

Latest info available at www.st.com

X-NUCLEO-CCA02M1
Important Hardware Additional Information

Hardware Overview (7/10)

- Before connecting the X-NUCLEO-IKS01A1 board with the X-NUCLEO-IDB04A1 (or X-NUCLEO-IDB05A1) expansion board through the Arduino UNO R3 extension connector, remove the 0-Ohm resistors SB25, SB26 and SB27, as shown in Figure 1.

- Before to connect X-NUCLEO-IKS01A2 with X-NUCLEO-CCAM02M1 expansion board through the Arduino UNO R3 extension connector, on to X-NUCLEO-IKS01A2 board remove these 0-ohm resistor, as shown in Figure 2:
  - For F4 STM32 Nucleo motherboard remove SB25, SB26 and SB27
  - For L4 STM32 Nucleo motherboard remove SB25 if additional microphones are plugged on to X-NUCLEO-CCA02M1 board.

- For only L4 STM32 Nucleo motherboard, before to connect the board X-NUCLEO-CCA02M1 with the STM32 L4 Nucleo motherboard through the Morpho connector layout, as shown in Figure 3 in the next slide on to X-NUCLEO-CCA02M1 board:
  - close the solder bridges SB12, SB16 and open the solder bridges SB7, SB15 and SB17
  - if additional microphones are plugged, close the solder bridge SB17.

Figure 1 – Modifications on the X-NUCLEO-IKS01A1 board

Figure 2 – Modifications on the X-NUCLEO-IKS01A2 board
Figure 3 – Modifications of the X-NUCLEO-CCA02M1 board
STEVAl-STLKT01V1 Hardware Description

- STEVAL-STLKT01V1 is the development kit for the SensorTile board (STLCS01V1), a highly Integrated Development Platform with a broad range of functionalities aiming to improve system design cycle and accelerate delivery of results.

- Two host boards are also provided as part of the kit, both featuring SWD programming interface:
  - Cradle expansion has a plugin connection for SensorTile Core System and an Arduino interface.
  - The Cradle is a small host featuring battery charger and SD card interface that supports on-the-field testing and data acquisition campaigns.
STEVAL-BCNKT01V1 Hardware Description

- STEVAL-BCNKT01V1 is the starter kit for the BlueCoin board (STEVAL-BCNCS01V1), a highly integrated development and prototyping platform for augmented acoustic and motion sensing, aiming to improve system design cycle and accelerate delivery of results.

- Two host boards are also provided as part of the kit:
  - The CoinStation provides audio output, battery management and two Time-of-flight ranging sensors.
  - The Cradle is a small host board featuring USB and SD card interfaces, it is useful for on-the-field testing and data acquisition campaigns.
Software Description

FP-SNS-ALLMEMS1 is an STM32 ODE function pack which lets you connect your IoT node to a smartphone via BLE and use a suitable Android™ or iOS™ like the BlueMS app to view real-time environmental sensor data, motion sensor data, digital microphone levels and battery level.

The package also enables advanced functionality such as voice communication over BLE, sound source localization and acoustic beam forming using inputs from multiple microphones, as well sensor data fusion and accelerometer-based real-time activity recognition, audio data logging and MEMS sensor data logging on SD card.

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

Key features

- Complete firmware to develop an IoT node with BLE connectivity, digital microphone, environmental and motion sensors.
- Middlewares libraries for sensor data fusion and accelerometer-based real-time activity recognition, acoustic source localization and beam forming, audio processing and streaming over BLE communication profile, SD Card data logging.
- Compatible with BlueMS application for Android/iOS, to perform sensors data reading, audio and motion algorithms features demo, and firmware update (FOTA).
- Easy portability across different MCU families, thanks to STM32Cube.
- Free, user-friendly license terms.

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FP-SNS-ALLMEMS1
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STM32 Open Development Environment: Overview
Setup & Demo Examples

HW prerequisites

- 1x Bluetooth Low Energy Expansion Board (X-NUCLEO-IDB05A1 or X-NUCLEO-IDB04A1)
- 1x Motion MEMS and Environmental Sensor Expansion Board (X-NUCLEO-IKS01A1 or X-NUCLEO-IKS01A2)
- 1x Digital MEMS Microphone Expansion Board (X-NUCLEO-CCA02M1)
- 1x STM32 Nucleo Development Board (NUCLEO-F401RE or NUCLEO-F446RE or NUCLEO-L476RG)
- 1x Android™ or iOS™ device
- 1x PC with Windows 7 and above
- 1x USB type A to Mini-B USB cable

It is necessary to connect the boards in the order shown in this picture.
Setup & Demo Examples

HW prerequisites and setup with BlueCoin (1/2)

- 1x BlueCoin Kit (**STEVAL-BCNKT01V1**):
  - BlueCoin Core System: BCNCS01V1
  - BlueCoin Coin Station: BCNST01V1
  - BlueCoin Cradle: BCNCR01V1
  - Battery
  - Programming cable

- 1x Android™ or iOS™ device

- 1x PC with Windows 7 and above

- 1x STM32-Nucleo or ST-Link programmer

- 1x USB type A to Mini-B USB cable for the ST-Link

- 1x USB type A to Micro-B USB cable for BlueCoin Cradles and Coin Station

BlueCoin Kit

![Mini USB](image1.png)

![Micro USB](image2.png)

![STM32 Nucleo board](image3.png)
Setup & Demo Examples
HW prerequisites and setup with BlueCoin (2/2)

• In order to program the board you need to connect an external ST-Link to the SWD connector on the cradles, a 5pin flat cable is provided within the BlueCoin Kit package

• The easiest way is to get an STM32-Nucleo board which includes an ST-Link V2.1 programmer

• Be sure that CN2 Jumpers are OFF and connect your STM32 Nucleo board to the ClueCoin Coin Station through the provided cable paying attention to the polarity of the connectors. Pin 1 can be identified by a little circle on the PCB silkscreen (STM32 Nucleo board and BlueCoin Coin Station)
Setup & Demo Examples

HW prerequisites and setup with SensorTile (1/2)

- 1x SensorTile Kit (STEVAL-STLKT01V1):
  - SensorTile Core System: STLCS01V1
  - SensorTile Cradle eXpansion: STLCX01V1
  - SensorTile Cradle: STLCR01V1
  - Battery
  - Programming cable

- 1x Android™ or iOS™ device

- 1x PC with Windows 7 and above

- 1x STM32-Nucleo or ST-Link programmer

- 1x USB type A to Mini-B USB cable for the ST-Link

- 1x USB type A to Micro-B USB cable for SensorTile Cradles
• In order to program the board you need to connect an external ST-Link to the SWD connector on the cradles, a 5pin flat cable is provided within the SensorTile Kit package.

• The easiest way is to get an STM32-Nucleo board which includes an ST-Link V2.1 programmer.

• Be sure that CN2 Jumpers are OFF and connect your STM32 Nucleo board to the SensorTile Cradle through the provided cable paying attention to the polarity of the connectors. Pin 1 can be identified by a little circle on the PCB silkscreen (STM32 Nucleo board and SensorTile Cradle Expansion) or by the square shape of the soldering pad of the connector (SensorTile Cradle).
Setup & Demo Examples
SW prerequisites

• STSW-LINK009
  • ST-LINK/V2-1 USB driver

• STSW-LINK007
  • ST-LINK/V2-1 firmware upgrade

• FP-SNS-ALLMEMS1
  • Copy the .zip file content into a folder on your PC. The package will contain source code example (Keil, IAR, System Workbench) based only on NUCLEO-F446RE or NUCLEO-F401RE or NUCLEO-L476RG or STEVAL-BCNKT01V1 or STEVAL-STLKT01V1

• BlueMS Application for Android/iOS to download from Google Store / iTunes
FP-SNS-ALLMEMS1

Bluetooth low energy and sensors software

1. www.st.com/stm32ode-fp

2. Select FP-SNS-ALLMEMS1

3. Download & unpack

4. FP-SNS-ALLMEMS1 package structure

   - Docs
   - BSP, HAL and drivers
   - BlueNRG, Audio, Motion, FatFs
   - Application example
   - Boot loader binary

   \Projects\Multi\Applications\ALLMEMS1\EWARM\STM32F401RE-Nucleo

5. Compile/Flash and Run the project

6. Android™/iOS™ smartphone and ST BlueMS application

IMPORTANT:
Read the chapter “The Boot Process” on User Manual for understanding how to install the Boot Loader on the board.
1. How to install the pre-compiled binary:
   • There is inside the package one folder called “Binary”

   • It contains:
     • pre-compiled FP-SNS-ALLMEMS1 FW for X-NUCLEO-IKS01A1 and for X-NUCLEO-IKS01A2 that could be flashed to a supported STM32 Nucleo or SensorTile Board using the ST-Link at the right position (0x08004000)
       • Important Note: this pre-compiled binary is compatible with the FOTA update procedure

     • pre-compiled FP-SNS-ALLMEMS1+BootLoader FW for X-NUCLEO-IKS01A1 and for X-NUCLEO-IKS01A2 that could be directly flashed to a supported STM32 Nucleo or SensorTile Board using the ST-Link or by doing “Drag & Drop” (the latter only for STM32 Nucleo boards)
       • Important Note: this pre-compiled binary is not compatible with the FOTA update procedure
2. How Install the code after compiling the project:

- Compile the project with your preferred IDE

- On Windows: for each IDE and for each platform there is one batch script:
  - IAR toolchain Embedded Workbench V7.80.4:
    - CleanALLMEMS1_IAR_IKS01A1 xxx.bat (xxx → F446 or F401 or L476)
    - CleanALLMEMS1_IAR_IKS01A2 xxx.bat (xxx → F446 or F401 or L476)
    - CleanALLMEMS1_IAR_yy.bat (yy → ST or BC)
  - System Workbench for STM32 Version 2.1.2.201709081530:
    - CleanALLMEMS1_SW4STM32_IKS01A1 xxx.bat (xxx → F446 or F401 or L476)
    - CleanALLMEMS1_SW4STM32_IKS01A2 xxx.bat (xxx → F446 or F401 or L476)
    - CleanALLMEMS1_SW4STM32_yy.bat (yy → ST or BC)
  - µVision toolchain - MDK-ARM Professional Version: 5.22:
    - CleanALLMEMS1_MDK_ARM_IKS01A1 xxx.bat (xxx → F446 or F401 or L476)
    - CleanALLMEMS1_MDK_ARM_IKS01A2 xxx.bat (xxx → F446 or F401 or L476)
    - CleanALLMEMS1_MDK_ARM_yy.bat (yy → ST or BC)
  - For Linux/iOS: only for Openstm32 IDE and for each platform there is one OpenOCD:
    - For Nucleo F446/F401/L476:
      - CleanALLMEMS1_SW4STM32_IKS01A1 xxx.sh (xxx → F446 or F401 or L476)
      - CleanALLMEMS1_SW4STM32_IKS01A2 xxx.sh (xxx → F446 or F401 or L476)
    - For STEVAL-STLKT01V1/STEVAL-BCNKT01V1:
      - CleanALLMEMS1_SW4STM32_yy.sh (yy → ST or BC)

It’s necessary to edit this file for setting the right installation and Library path

- These scripts perform the following steps:
  1. Full Flash Erase
  2. Flash the right BootLoader at the right position (0x08000000)
  3. Flash the ALLMEMS1 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
  4. Save a complete Binary FW that includes both ALLMEMS1 and the BootLoader
    - This binary can be directly flashed to a supported STM32 Nucleo or SensorTile board or BlueCoin board using the ST-Link or by doing “Drag & Drop” (the latter only for STM32 Nucleo boards)
    - Important Note: this additional pre-compiled binary is not compatible with the FOTA update procedure
FP-SNS-ALLMEMS1
Flash Management and Boot Process

Flash Structure

Boot Sequence

START → OTA?

YES → Erase "Region 2"
→ Copy FOTA from "Region 3" to "Region 2"
→ Delete FOTA "magic number" in "Region 3"
→ Restart the board

NO → JUMP TO APPLICATION
Using serial line monitor – e.g. Tera Term

FP-SNS-ALLMEMS1 for NUCLEO-F401RE / NUCLEO-F446RE / NUCLEO-L476RG

- Pressing the **RESET** User button on STM32 Nucleo board
  You could see 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)
BlueMS Application for Android/iOS (1/6)

Environmental page

Accelerometer plot

Microphones level plot

DS3/DSM/DSL Menu Events

RSS & Battery Page

**Known Limitation**

For NUCLEO-F401RE and NUCLEO-F446RE board, there is a hardware conflict between the boards X-NUCLEO-IKS01A2 and the X-NUCLEO-CCA02M1. The hardware features of the LSM6DSL are disabled.

**Note**

For the STEVAL-STLKT01V1, when the Android/iOS device is not connected for more than fixed range time, the board go on shutdown mode. The accelerometer event can be selected and used to wake-up the board to connect it to Android/iOS again (The Double Tap event is set as default).
**NOTE**

When the data logging starts, the other BlueMS app functions are disabled and the data logging goes on even if the app is closed. If the logging interval is more than 20 sec, when the Android/iOS device is not connected and the logging is started, after 20 seconds the board go on shutdown mode. The RTC alarm is used to wake-up the board in order to log the selected data with the logging interval chose. The accelerometer event can be selected and used to wake-up the board to connect it with the Android/iOS device for stopping the logging (The Double Tap event is set as default).

(1) Feature not available on NUCLEO-F446RE, NUCLEO-F401RE and STEVAL-BCNKT01V1
(2) Feature not available on STEVAL-STLKT01V1
(3) Feature not available on STEVAL-STLKT01V1 and NUCLEO-L476RG
(4) Feature available on STEVAL-STLKT01V1
BlueMS Application for Android/iOS (3/6)

If Settings is chosen, it is possible to change the node name using the node configuration.
For only STEVAL-STLKT01V1 (SensorTile) SD data logging is available for Environmental, Magnetometer, Gyroscope, Accelerometer and Audio data.

Below, the debug console commands to start the data logging:

- `start/stop`: to start/stop the data logging for environmental, Accelerometer, Magnetometer and Gyro data.
- `AudioStart/AudioStop`: to start/stop the data logging for Audio data.

It is not possible starting the data logging for MEMS and audio data together.

When the data logging is started (audio or MEMS), the others functionality of the BlueMS app is disabled and the data logging go on even if the app is closed (It is necessary to restart the app if the data logging must be stopped).
BlueMS Application for Android/iOS (5/6)

BlueMS: menu option

BlueMS: Firmware update file selection

BlueMS: Firmware upgrade page

BlueMS: application page during FOTA and on completion

Terminal window information during FOTA (only for STM32 Nucleo F4/L4 series)
FP-SNS-ALLMEMS1

BlueMS Application for Android/iOS (6/6)

BlueVoice Library – Android Version

Insert here a valid ASR key

Hold on & speak!

Recording...

Sending request...

hello what's your name

Key Inserted, ASR Enabled!

Token not recognized

Codec: ADPCM
Sampling freq: 8 kHz
ASR: Enabled
Volume: 
RecordTime: 

Codec: ADPCM
Sampling freq: 8 kHz
ASR: Enabled
Volume: 

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

FP-SNS-ALLMEMS1
- **DB2915**: STM32 ODE function pack for Bluetooth low energy and sensor software expansion for STM32Cube – **data brief**
- **UM2059**: Getting started with the FP-SNS-ALLMEMS1 Bluetooth low energy and sensors software expansion for STM32Cube – **user manual**
- Software setup file

X-NUCLEO-CCA02M1
- Gerber files, BOM, Schematics
- **DB2593**: Digital MEMS microphones expansion board based on MP34DT01-M for STM32 Nucleo – **data brief**
- **UM1900**: Getting started with the digital MEMS microphones expansion board based on MP34DT01-M 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-IDB04A1
- Gerber files, BOM, Schematic
- **DB2316**: Bluetooth Low Energy expansion board based on BlueNRG for STM32 Nucleo – **data brief**
- **UM1765**: Getting started with Bluetooth® low energy expansion board based on BlueNRG for STM32 Nucleo – **user manual**

Consult www.st.com for the complete list
Documents & Related Resources

All documents are available in the DESIGN 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-IKS01A1
- Gerber files, BOM, Schematic
- **DS10619**: Motion MEMS and environmental sensor expansion board for STM32 Nucleo – data brief
- **UM1820**: Getting started with motion MEMS and environmental sensor expansion board for STM32 Nucleo – user manual

STEVAL-STLKT01V1
- Gerber files, BOM, Schematic
- **DB2956**: SensorTile development kit – data brief
- **UM2101**: Getting started with the STEVAL-STLKT01V1 SensorTile integrated development platform – user manual

STEVAL-BCNKT01V1
- Gerber files, BOM, Schematic
- **DB3258**: BlueCoin Starter kit – data brief
- **UM2240**: Getting started with the STEVAL-BCNKT01V1 BlueCoin starter kit: augmented acoustics, motion sensing development and prototyping platform – user manual

Consult www.st.com for the complete list
FP-SNS-ALLMEMS1: STM32 ODE function pack for IoT node with BLE connectivity, digital microphone, environmental and motion sensors

Hardware and Software overview

Setup & Demo Examples
Documents & Related Resources

STM32 Open Development Environment: Overview
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.
• A comprehensive range of affordable development boards for all the STM32 microcontroller series, with unlimited unified expansion capabilities and integrated debugger/programmer functionality.
STM32 Nucleo Expansion Boards (X-NUCLEO)

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

Example of STM32 expansion board (X-NUCLEO-IKS01A1)
**STM32 Open Development Environment**

**Software components**

- **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.

- **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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**Tools & IDEs**
- IAR EWARM, Keil MDK-ARM, GCC-based IDEs (e.g. Ac6 System Workbench for STM32)

**Applications**
- Sample applications (e.g. based on ST OpenSoftwareX)

**Middleware**
- STM32Cube middleware
- Upper level middleware (e.g. ST OpenSoftwareX)
- STM32Cube expansion middleware

**Hardware Abstraction**
- STM32Cube Hardware Abstraction Layer (HAL)

**Hardware**
- STM32 Nucleo expansion boards (X-NUCLEO)
- STM32 Nucleo developer boards

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**OPEN LICENSE MODELS:** STM32Cube software and sample applications are covered by a mix of fully open source BSD license and ST licenses with very permissive terms.

www.st.com/stm32cube

www.st.com/x-cube
STM32 Open Development Environment

Building block approach

The building blocks

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

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

- **Translate**
  - Audio amplifier
  - Touch controller
  - Operation Amplifier

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

- **Power**
  - Energy management & battery

- **Process**
  - General-purpose microcontrollers
  - Secure microcontrollers

- **Software**

Your need

The building blocks

Our answer

www.st.com/stm32ode