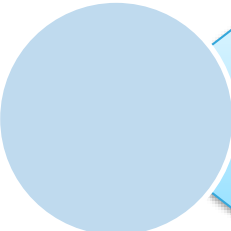# Quick Start Guide

STM32Cube function pack for STM32WB MCU featuring advanced audio streaming over Bluetooth 5.0 using Opus codec (FP-AUD-BVLINKWB1)
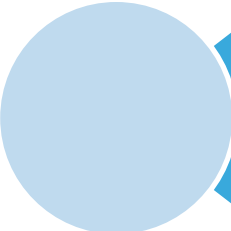
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Version 1.3 (Feb 7, 2020)

Quick Start Guide Contents

FP-AUD-BVLINKWB1: STM32Cube function pack for STM32WB MCU featuring advanced audio streaming over Bluetooth 5.0 using Opus codec

Setup & Demo Examples

Documents & Related Resources

STM32 Open Development Environment: Overview

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MEMS Microphones Expansion Board (CCA02M2)
Hardware Overview

Hardware Description

- The X-NUCLEO-CCA02M2 expansion board has been designed around MP34DT06J digital MEMS microphone. It is compatible with the ST morpho connector layout and with digital microphone coupon boards such as STEVAL-MIC001V1, STEVAL-MIC002V1 and STEVAL-MIC003V1.

- The X-NUCLEO-CCA02M2 embeds two MP34DT06J microphones and allows synchronized acquisition and streaming of up to 4 microphones through I²S, SPI, DFSDM or SAI peripherals.

Key Products on board

MP34DT06J

Is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface.

Morpho connector

Arduino UNO R3 connector

X-NUCLEO-CCA02M2

FOR EVALUATION ONLY
NOT FCC APPROVED FOR RESALE

☐ MP34DT01-M   ☐ Microphone coupons housing   ☐ USB Connector

Order Code: **X-NUCLEO-CCA02M2**

Latest info available at
X-NUCLEO-CCA02M2

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P-NUCLEO-WB55 pack

Hardware Overview

Key Products on board:
Nucleo68:

- STM32WB microcontroller in a VFQFPN68 package
- 2.4 GHz RF transceiver supporting Bluetooth® specification v5.0 and IEEE 802.15.4-2011 PHY and MAC
- Dedicated Arm® 32-bit Cortex® M0+ CPU for real-time Radio layer
- Three user LEDs
- Three user buttons and one reset button
- Board connector: USB user with Micro-B
- Board expansion connectors:
  - Arduino™ Uno V3
  - ST morpho
- Integrated PCB antenna or footprint for SMA connector
- Flexible power-supply options: ST-LINK USB VBUS or external sources
- On-board socket for CR2032 battery
- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability: mass storage, virtual COM port and debug port
- Comprehensive free software libraries and examples available with the STM32Cube package
- Support of a wide choice of Integrated Development Environments (IDEs), including IAR™, Keil®, GCC-based IDEs, Arm® Mbed™

P-NUCLEO-WB55 Hardware Description:

The P-NUCLEO-WB55 pack is a multi-protocol wireless and ultra-low-power device embedding a powerful and ultra-low-power radio compliant with the Bluetooth® Low Energy (BLE) SIG specification v5.0 and with IEEE 802.15.4-2011.
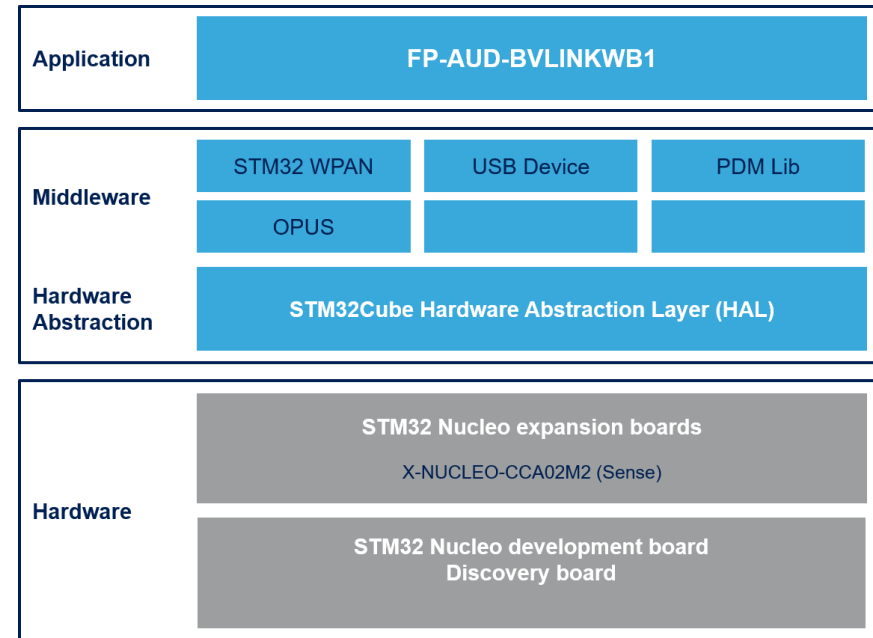

Latest info available at
P-NUCLEO-WB55

FP-AUD-BVLINKWB1 Software

- FP-AUD-BVLINKWB1 is an STM32Cube function pack that performs full-duplex voice streaming or stereo music streaming over BLE using the advanced Opus compression algorithm. The application runs on the P-NUCLEO-WB55 and includes drivers and middleware for BLE and digital MEMS microphones.

- Sample implementation available for X-NUCLEO-CCA02M2 connected to a P-NUCLEO-WB55

Key features

- Complete firmware to implement full-duplex audio or stereo music streaming over Bluetooth 5.0 using Opus codec for both encoding and decoding

- A BlueVoiceOPUS customized profile for audio over BLE, including an easy-to-use set of APIs to exploit advanced Opus functionality (source code available)

- Third-party Opus v1.3 (downloadable from http://opus-codec.org/) middleware: an open, royalty-free and highly versatile audio codec that is standardized by the Internet Engineering Task Force (IETF) as RFC 6716

- Digital audio signal acquisition and processing and Audio out playback through USB

- Compatibility with ST BLE Sensor app to perform audio streaming at 16 kHz and speech to text, or to stream stereo music @48kHz for devices supporting BLE 4.2 or higher

- Free, user-friendly license terms
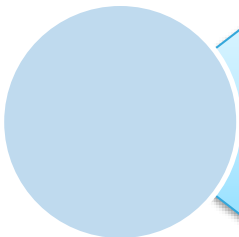
Overall Software Architecture

Application	**FP-AUD-BVLINKWB1**

Middleware	STM32 WPAN	USB Device	PDM Lib
	OPUS		
Hardware Abstraction	**STM32Cube Hardware Abstraction Layer (HAL)**		

Hardware	**STM32 Nucleo expansion boards** X-NUCLEO-CCA02M2 (Sense)
	STM32 Nucleo development board **Discovery board**

Latest info available at
FP-AUD-BVLINKWB1

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FP-AUD-BVLINKWB1: STM32Cube function pack for STM32WB MCU featuring advanced audio streaming over Bluetooth 5.0 using Opus codec

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Setup & Demo Examples
SW prerequisites

- **STSW-LINK004**:
  - STM32 ST-LINK Utility is a full-featured software interface for programming STM32 microcontrollers. You can use this utility to flash your Nucleo-WB55 board, for a fast demo setup.

- **FP-AUD-BVLINKWB1 v1.1.0 or higher**
  - Copy the .zip file content into a folder on your PC. The package contains source code example (Keil, IAR, STM32CubeIDE) based on **NUCLEO-WB55.**

- **ST BLE Sensor** App can be downloaded from relevant store.

- Third party software for audio acquisition:
  - Audacity® is free, open source, cross-platform software for recording and editing sounds.
  - It is available for Windows®, Mac®, GNU/Linux®; and other operating systems.
  - Link: http://audacity.sourceforge.net

1 www.st.com/stm32ode-fp

FP-AUD-BVLINKWB1 package structure

www.st.com

2 Select
FP-AUD-BVLINKWB1

3 Download & unpack

Name

_htmresc

Documentation ← Docs

Drivers ← BSP, HAL and drivers

Middlewares ← STM32WAN, Opus, USB…

Projects ← Application example

Utilities

package.xml

Release_Notes.html

4

5 Build the application
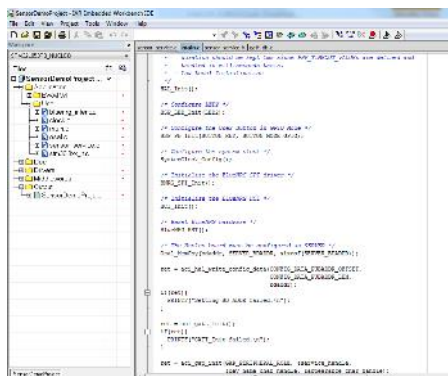
Open one project example
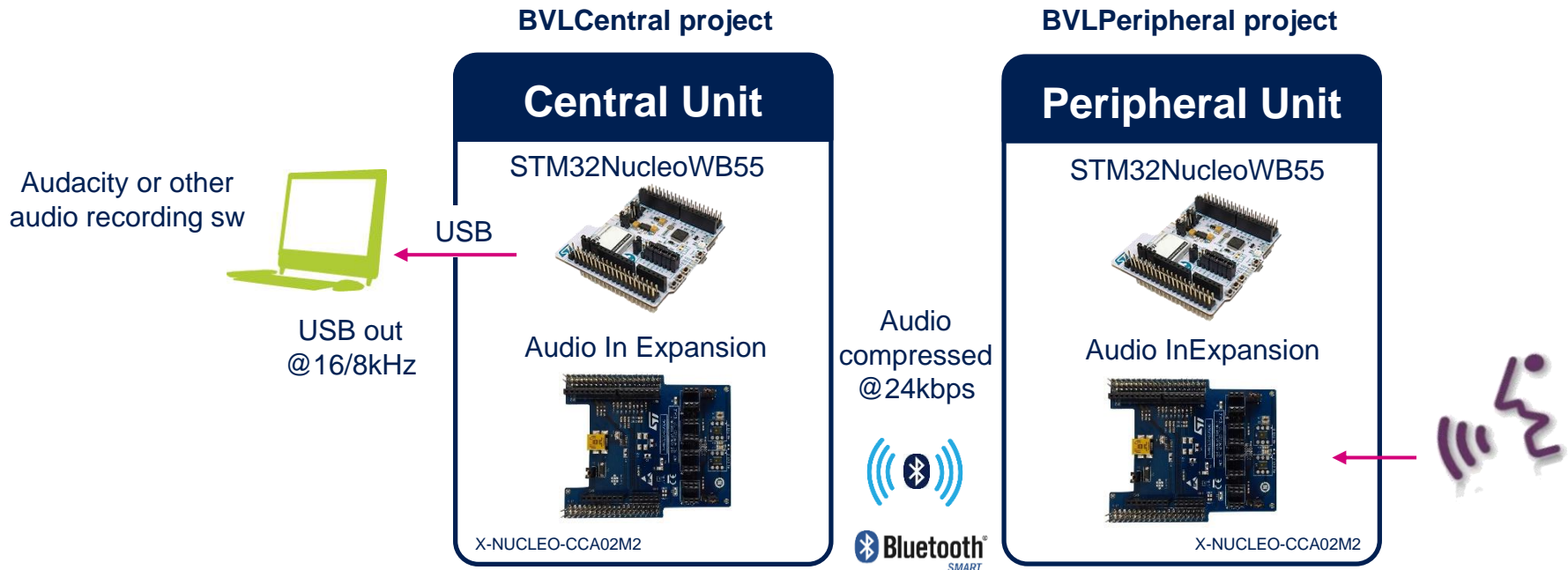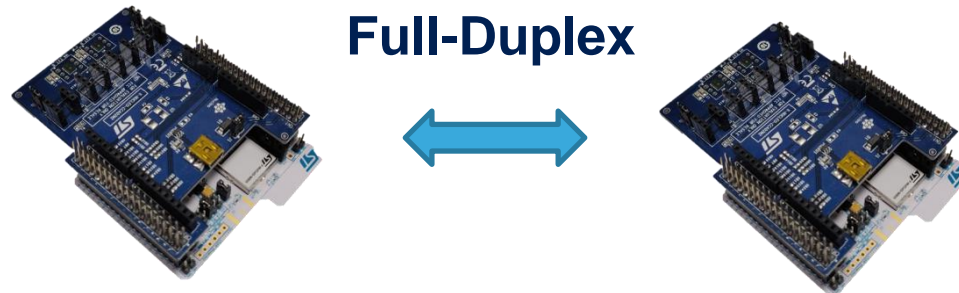"BVLCentral"
"BVLPeripheral"
"BVLPeripheral_FullBand"

KEIL Tools by ARM

IAR SYSTEMS

BVLCentral project

BVLPeripheral project

Central Unit

STM32NucleoWB55

Audio In Expansion

X-NUCLEO-CCA02M2

Peripheral Unit

STM32NucleoWB55

Audio InExpansion

X-NUCLEO-CCA02M2

Audacity or other audio recording sw

USB

USB out @16/8kHz

Audio compressed @24kbps

Bluetooth SMART

- 2x P-NUCLEO-WB55 development board for Full-Duplex communication.

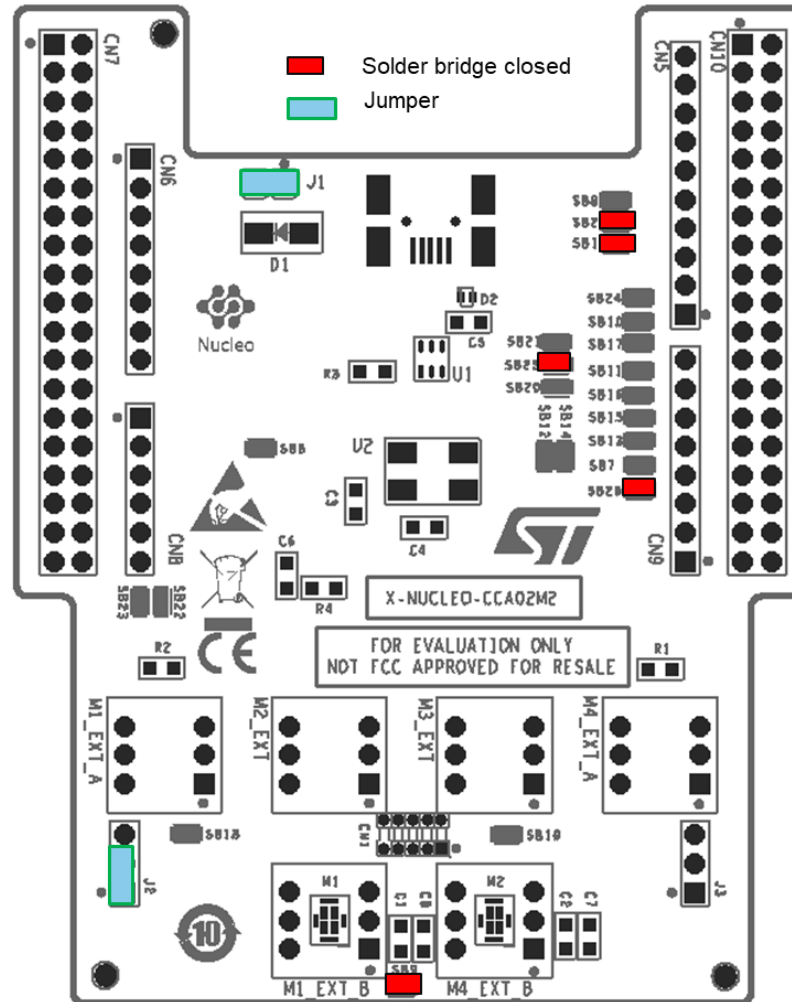- 2x STM32 Nucleo MEMS Microphones expansion board (**X-NUCLEO-CCA02M2**)

Full-Duplex

Configure the X-NUCLEO-CCA02M2 board as in the picture in order to acquire only one microphone through the SAI

Full-Duplex - Setup & Demo Examples

STM32Nucleo - Demo setup
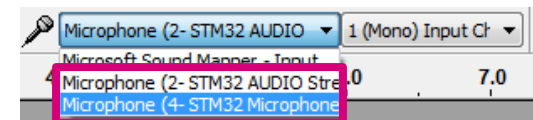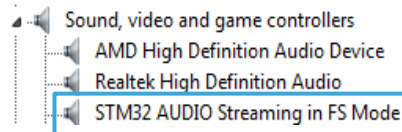
Central Unit   **Peripheral Unit**

1 Compile and download BVLCentral application on one unit and BVLPeripheral application on the other (see previous slide)

2 Move JP1 from USB STL to USB MCU.
Plug a micro USB cable into USB_USER

3 Both units are recognized as USB Microphone.

Sound, video and game controllers
- AMD High Definition Audio Device
- Realtek High Definition Audio
- STM32 AUDIO Streaming in FS Mode

Microphone (2- STM32 AUDIO ▼ | 1 (Mono) Input Ch ▼
Microsoft Sound Mapper - Input
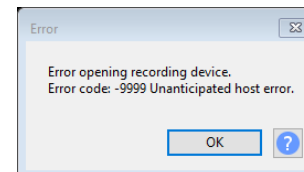Microphone (2- STM32 AUDIO Stre
Microphone (4- STM32 Microphone

4 Open Audacity, select the peripheral or central unit and click record *

5 On Nucleo-WB55 press SW1 user button to START streaming, press again to STOP it. Both units can stream at the same time.
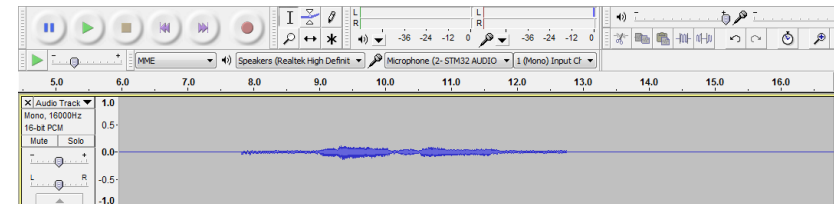
6 Audacity records audio coming from the selected microphone.

Error
Error opening recording device.
Error code: -9999 Unanticipated host error.
OK

* In windows 10, if an error occurs please delete the audio driver from device manager and unplug and replug the usb cable from Nucleo board

Simplex - Setup & Demo Examples

ST BLE Sensor app

1 Prepare BVLPeripheral module (same used for full-duplex demo) and power it on

Available for Android and iOS

2 Open the ST BLE Sensor app on Android or iOS device

3 Connect to "BVL-WB1" from the device list

4 You can play back the audio stream received from the ST device or record and save the received audio

5 Exploit web-based speech to text service in different languages. For further information refer to ST BLE Sensor app User Manual
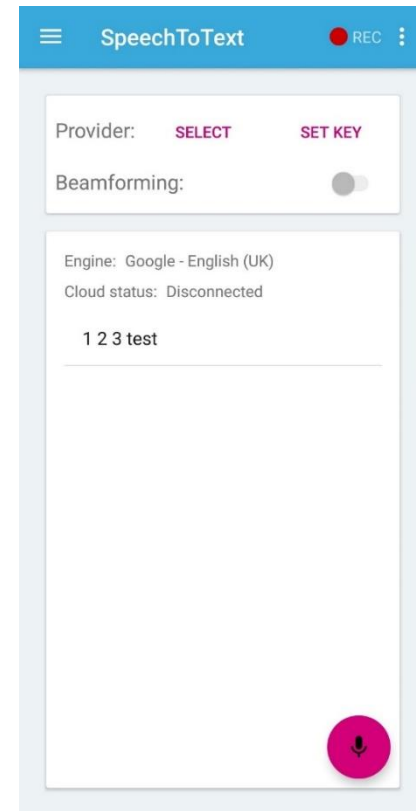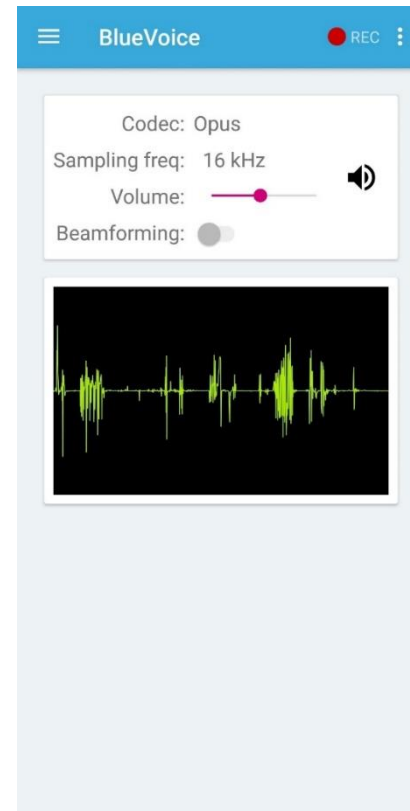
Full-Band - Setup & Demo Examples
STM32Nucleo - System overview

Central Unit

ST BLE Sensor App

Peripheral Unit

BVLPeripheral_FullBand

P-NUCLEO-WB55

Audacity or other
audio recording sw

Audio
Compressed
96/192 kbps

Output: 2 channel
48kHz

USB

Bluetooth® SMART
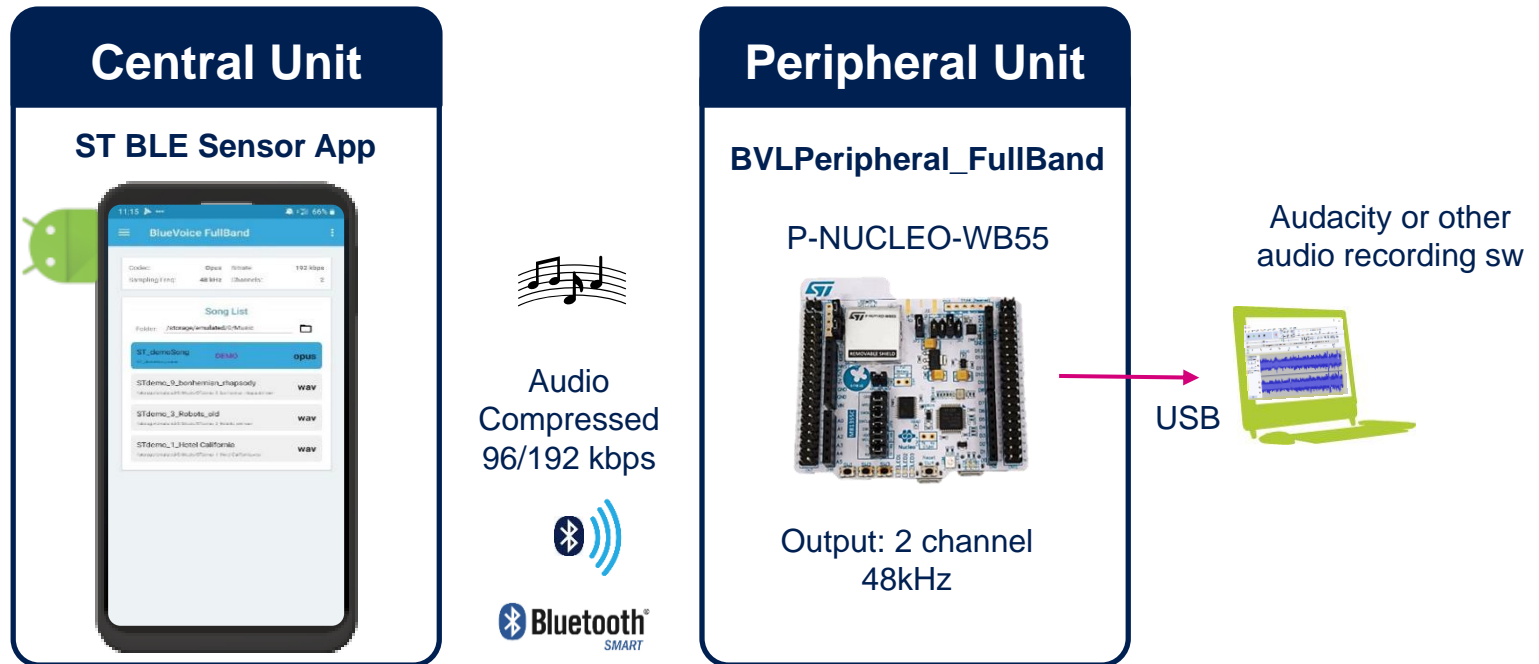
- 1x P-NUCLEO-WB55 development board

- Android device supporting BLE 4.2 and running ST BLE Sensor App

life.augmented

Full-Band - Setup & Demo Examples

Central Unit

Peripheral Unit

1 Compile and download BVLPeripheral_Fullband application on the P-NUCLEO-WB55

IAR SYSTEMS **KEIL Tools by ARM** **STM32 CubeIDE**

2 Move JP1 from USB STL to USB MCU.
Plug a micro USB cable into USB_USER

3 STM32WB is recognized as USB Microphone.
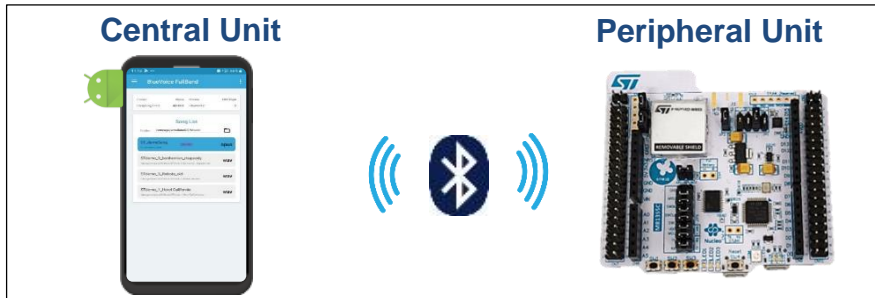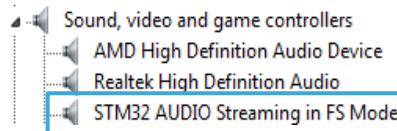
Sound, video and game controllers
AMD High Definition Audio Device
Realtek High Definition Audio
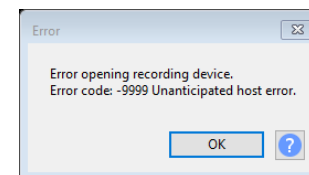STM32 AUDIO Streaming in FS Mode

4 Open Audacity, select the peripheral unit and click record *

5 Open ST BLE Sensor App on you android device and connect to BVFBAND. Choose a track and press play. (you can import wav file from your device)

6 Audacity records 48kHz stereo music coming from the Android device.
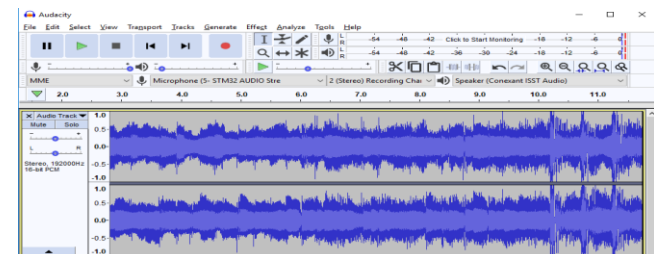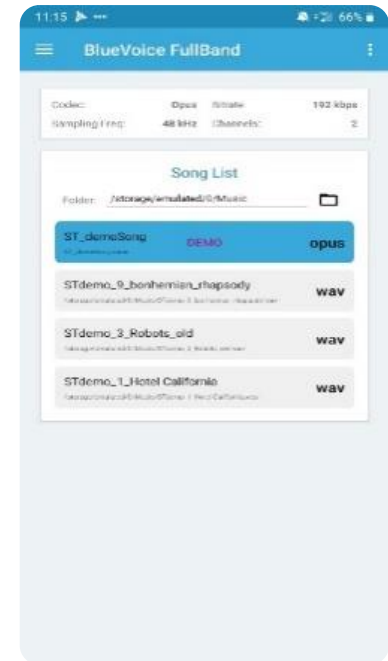
Error opening recording device.
Error code: -9999 Unanticipated host error.

OK

***** In windows 10, if an error occurs please delete the audio driver from device manager and unplug and replug the usb cable from Nucleo board

BlueVoice FullBand

| Codec: | Opus | | 192 kbps |
| Sampling Freq: | 48 kHz | Channels: | 2 |

Song List

Folder: /storage/emulated/0/Music

ST_demoSong	DEMO	opus
STdemo_9_bonhemian_rhapsody		wav
STdemo_3_Robots_old		wav
STdemo_1_Hotel California		wav

Documents & Related Resources

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

FP-AUD-BVLINKWB1:

- **DB3973**: STM32Cube function pack for STM32WB MCU featuring advanced audio streaming over Bluetooth 5.0 using Opus codec– **Data Brief**

- **UM2614:** Getting started with the STM32Cube function pack for STM32WB MCU featuring advanced audio streaming over Bluetooth 5.0 using Opus codec– **User Manual**

- Software setup file

X-NUCLEO-CCA02M2
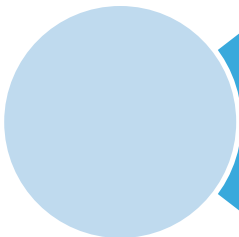
- Gerber files, BOM, Schematics

- **DB4016:** Digital MEMS microphones expansion board based on MP34DT06-J for STM32 Nucleo **– Data Brief**

- **UM2631:** Getting started with the digital MEMS microphones expansion board based on MP34DT06-J for STM32 Nucleo – **User Manual**
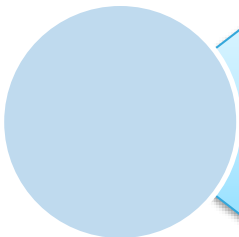
Consult www.st.com for the complete list

Quick Start Guide Contents

FP-AUD-BVLINKWB1: STM32Cube function pack for STM32WB MCU featuring advanced audio streaming over Bluetooth 5.0 using Opus codec

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
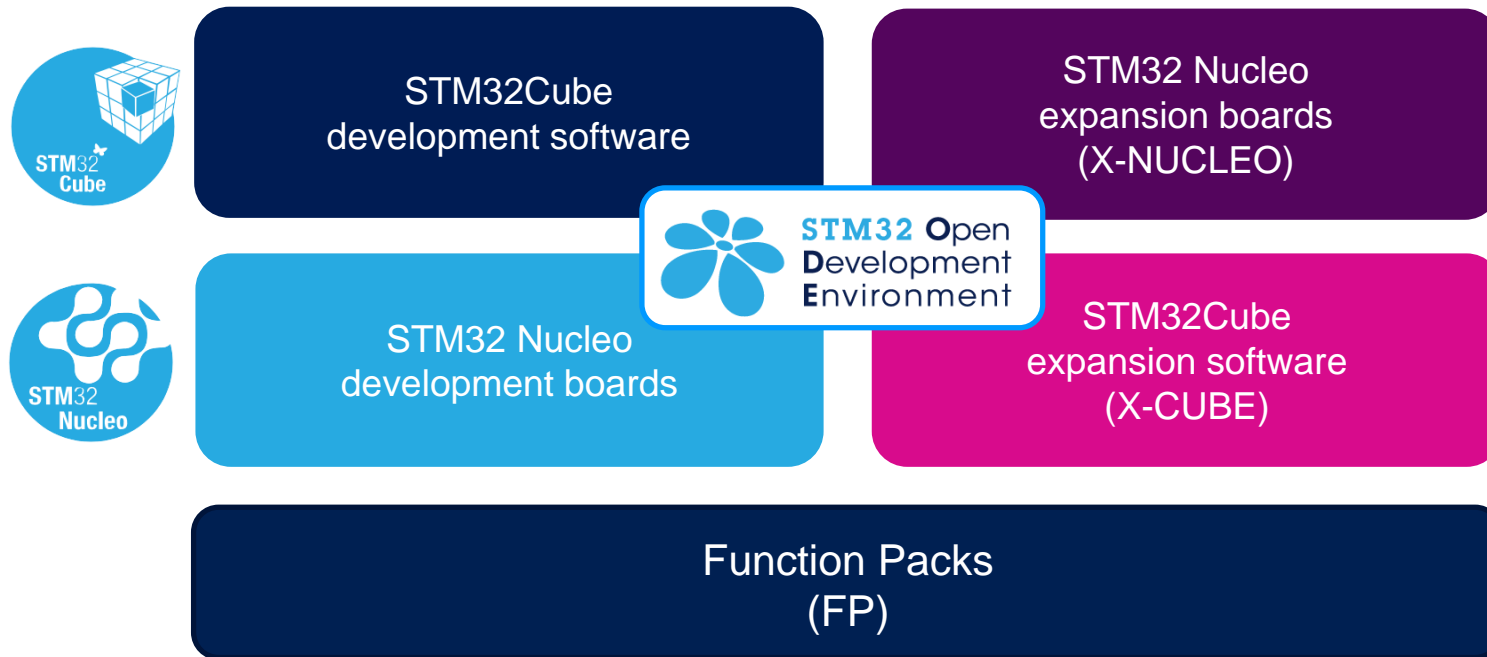
STM32 Nucleo
Development Boards (NUCLEO)

- 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

www.st.com/stm32nucleo
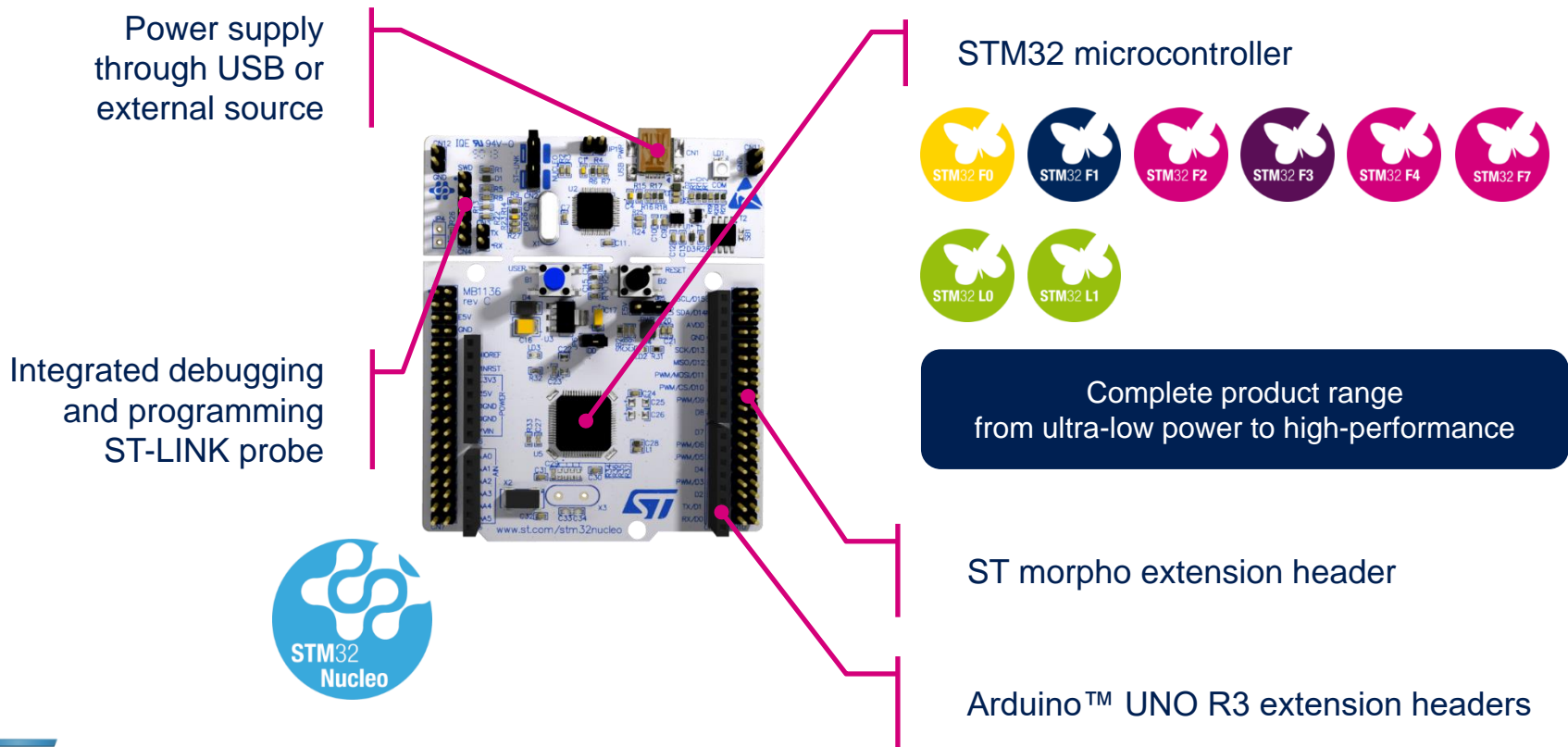
STM32 Nucleo
Expansion Boards (X-NUCLEO)

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

Connect

Power

Move/Actuate

Interact

Sense

Motion MEMS sensors

Environmental sensors

DIL24 support for new devices

Example of STM32 expansion board (X-NUCLEO-IKS01A1)

www.st.com/x-nucleo
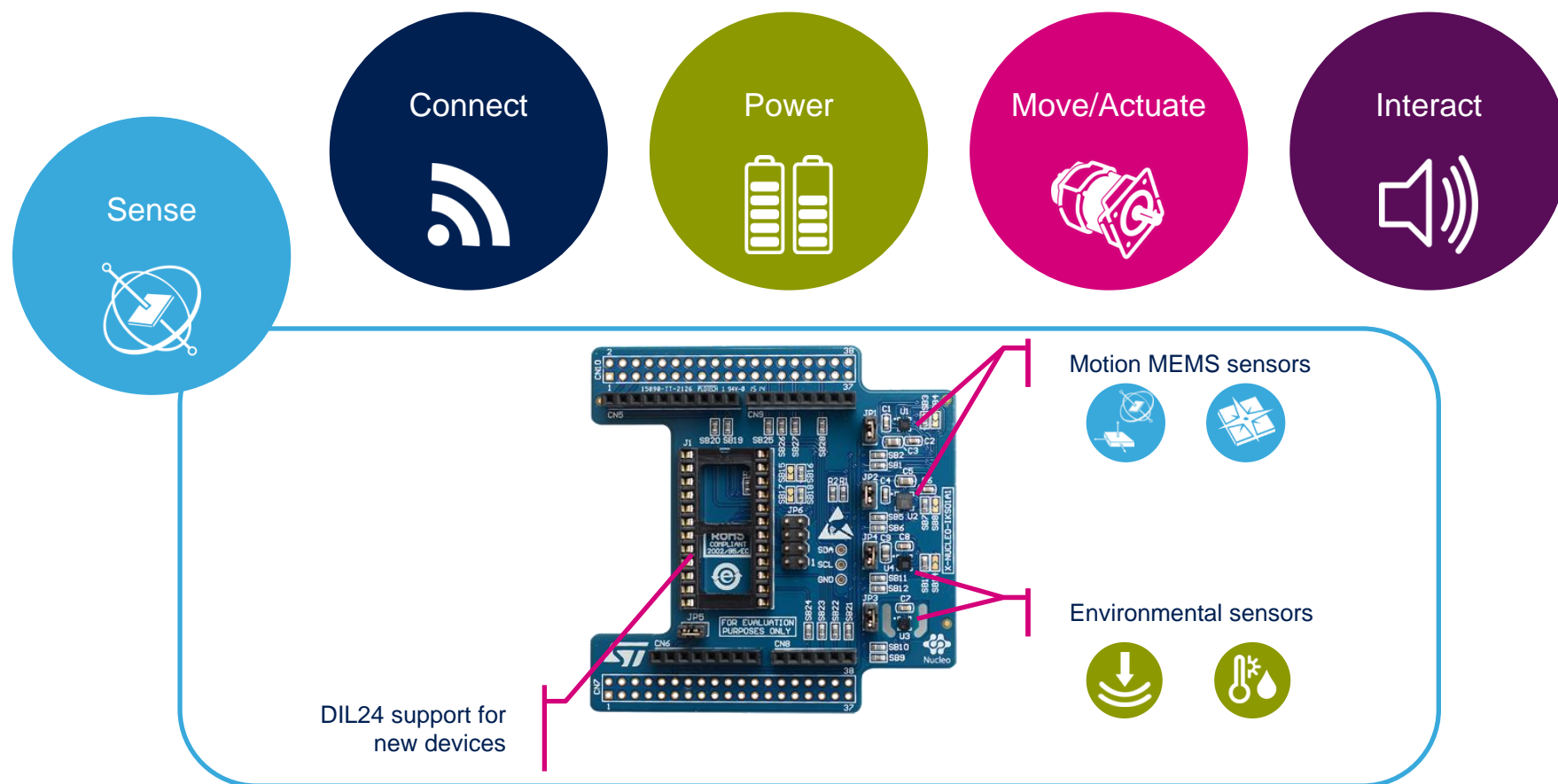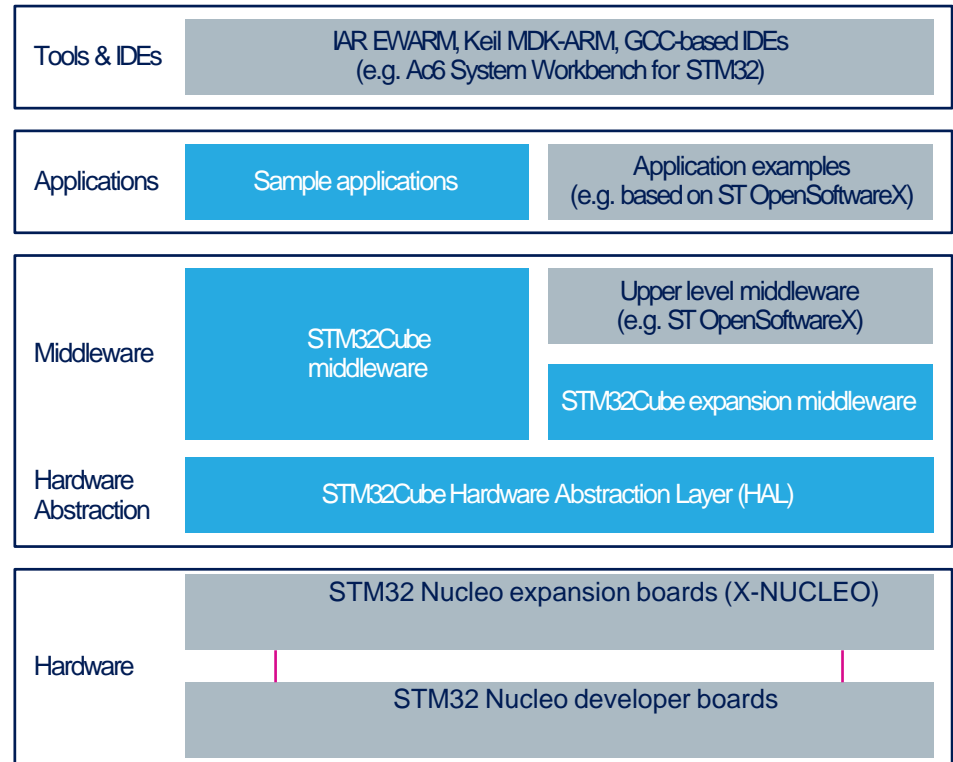
STM32 Open Development Environment
Software components

- **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.

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 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	

- **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.

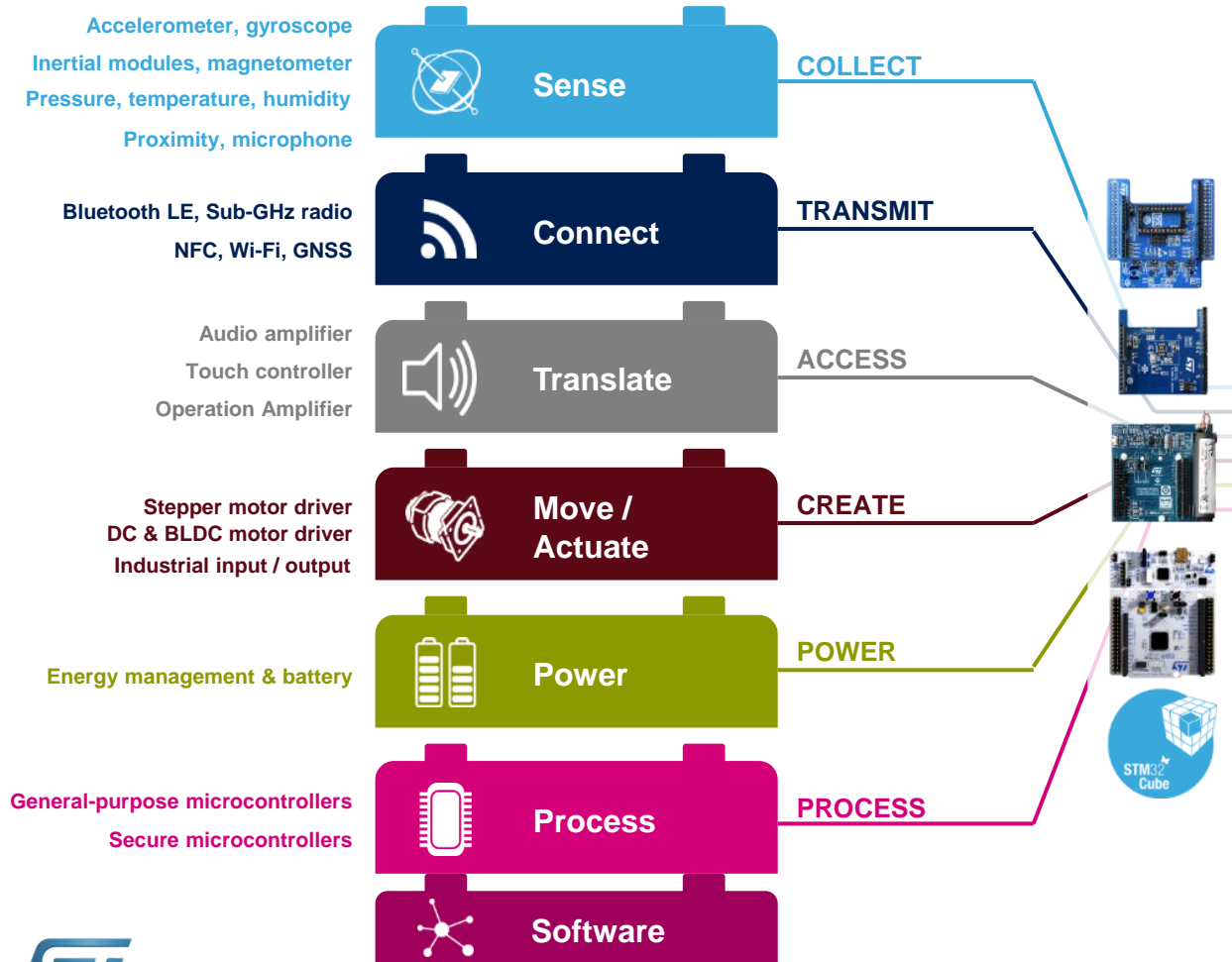**OPEN LICENSE MODELS:** STM32Cube software and sample applications are covered by a mix of fully open source BSD license and ST licenses with very permissive terms.

www.st.com/stm32cube

www.st.com/x-cube

life.augmented

STM32 Open Development Environment
Building block approach

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 **O**pen **D**evelopment **E**nvironment

STM32Cube

www.st.com/stm32ode