Quick Start Guide

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

Version 3.0 (Feb 18, 2021)

Agenda

1- Hardware and Software overview
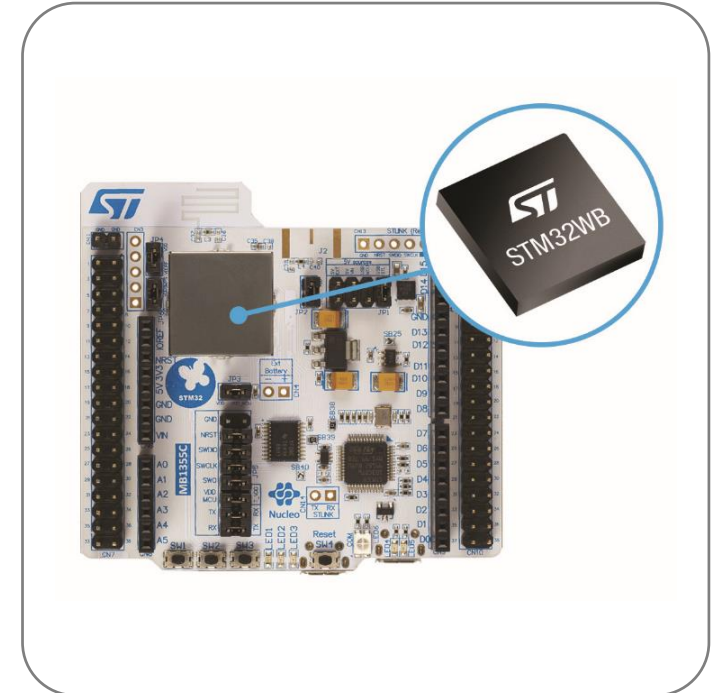
P-NUCLEO-WB55 Hardware Description:

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.

Key Product on board

- 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™

Latest info available at www.st.com
P-NUCLEO-WB55

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STM32WB5MM-DK Hardware Description:

The STM32WB5MM-DK Discovery kit is designed as a complete demonstration and development platform for the STMicroelectronics STM32W5MMG module based on the Arm® Cortex®-M4 and Arm® Cortex®-M0+ cores.

Key Product on board

- STM32WB5MMG (1-Mbyte Flash memory, 256-Kbyte SRAM, in Module RF package)
  - Dual-core 32-bit (Arm® Cortex®-M4 and dedicated M0+ CPU for real-time radio layer)
  - 2.4 GHz RF transceiver supporting Bluetooth® specification V5.2, 802.15.4 with Zigbee®, Thread®, and proprietary protocols
- 0.96-inch 128x64 OLED display
- 128-Mbit Quad-SPI NOR Flash Memory
- Temperature sensor
- Accelerometer/gyroscope sensor
- Time-of-Flight and gesture-detection sensor
- Digital microphone
- RGB LED Infrared LED
- 3 push-buttons (2 users and 1 reset) and 1 touch key button
- Connectors: STMod+, ARDUINO® Uno V3 expansion connector, USB user Micro-B connector, TAG10 10-pin footprint
- Flexible power-supply options: ST-LINK/V2-1 USB connector, 5 V delivered by ARDUINO® or external connector, USB charger, or USB power
- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability: Virtual COM port and debug port
- Comprehensive free software libraries and examples available with the STM32CubeWB MCU Package
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE
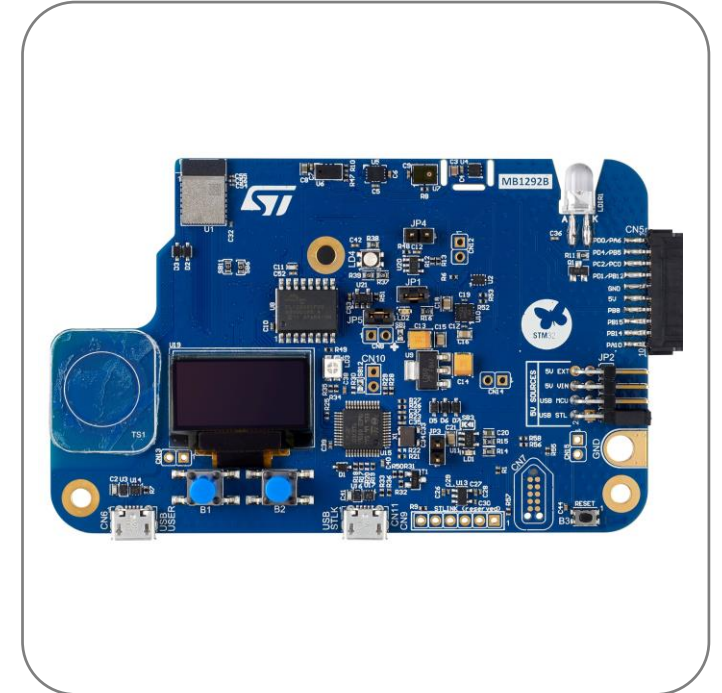
Latest info available at www.st.com
STM32WB5MM-DK

# MEMS Microphones Expansion Board (CCA02M2)
Hardware Overview

X-NUCLEO-CCA02M2 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 Product on board

- 2 on-board MP34DT06J digital MEMS microphones

- 6 slots to plug in digital microphone coupon boards such as STEVAL-MIC001V1, STEVAL-MIC002V1 and STEVAL-MIC003V1

- Synchronized acquisition and streaming of up to 4 microphones

- Free comprehensive development firmware library and audio capture plus USB streaming sample application compatible with STM32Cube

- Compatible with STM32 Nucleo boards

- Equipped with ST morpho connector (upwards and downwards)

- Equipped with Arduino UNO R3 connector (upwards) to allow multiple boards

- RoHS and WEEE compliant
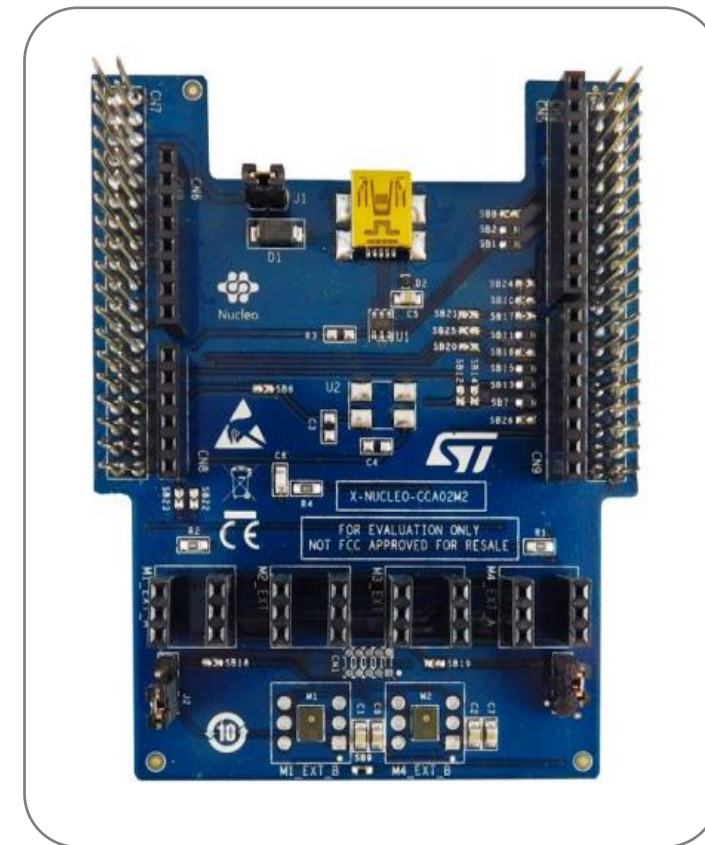
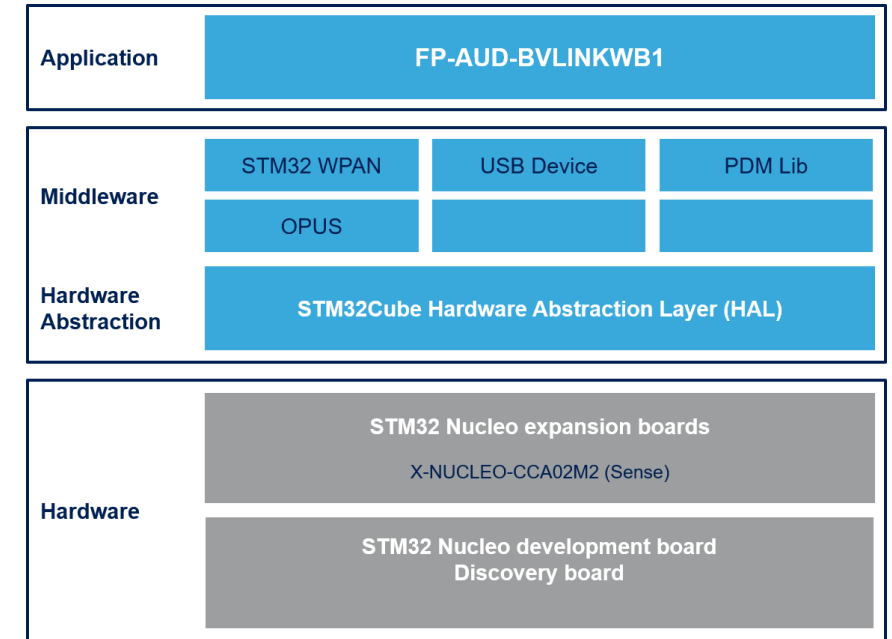Latest info available at www.st.com
X-NUCLEO-CCA02M2

life.augmented

FP-AUD-BVLINKWB1 Software Description

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 P-NUCLEO-WB55 connected to an X-NUCLEO-CCA02M2 or on STM32WB5MM-DK.

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

- Audio out playback through USB

- Compatibility with STBLESensor mobile app, to perform full-duplex audio streaming at 16 kHz and speech-to-text or to receive stereo music at 48 kHz from 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 www.st.com
FP-AUD-BVLINWB1

2- Setup & Demo Examples

Setup & Application Examples
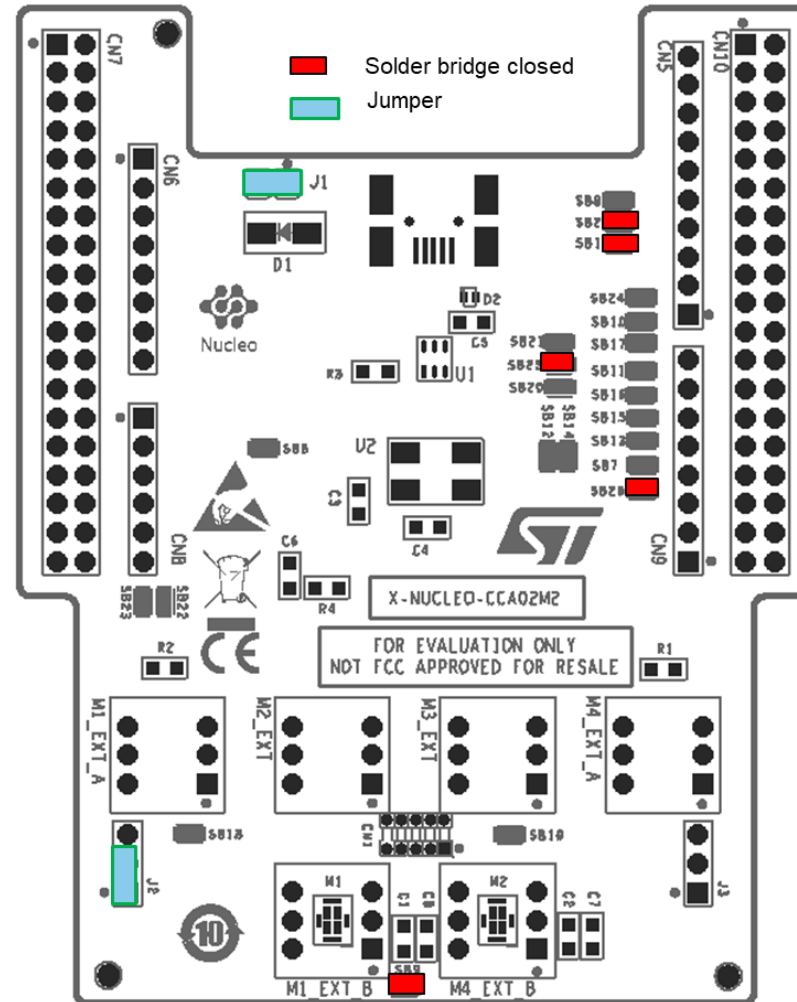
HW prerequisites for Full-Duplex demo between two STM32WB

- Full-Duplex audio streaming between two STM32WB (P-NUCLEO-WB55 or STM32WB5MM-DK)

  - 2x P-NUCLEO-WB55 development board + 2x X-NUCLEO-CCA02M2 expansion board; alternatively, 2x STM32WB5MM-DK

  - Laptop/PC with Windows 7, 8 or 10 and Audacity or other audio recording sw

  - 2x micro-USB cables

- Full-Duplex audio streaming between STM32WB (P-NUCLEO-WB55 or STM32WB5MG-DK) and a mobile device

  - 1x P-NUCLEO-WB55 development board + 1x X-NUCLEO-CCA02M2 expansion board; alternatively, 1x STM32WB5MM-DK

  - Laptop/PC with Windows 7, 8 or 10 and Audacity or other audio recording sw

  - 1x micro-USB cable

  - 1x mobile device running ST BLE Sensor App (v4.9.0 or higher)

- Full-Band stereo music streaming:

  - 1x P-NUCLEO-WB55 or 1x STM32WB5MM-DK

  - Laptop/PC with Windows 7, 8 or 10 and Audacity or other audio recording sw

  - 1x micro-USB cable

  - 1x mobile device running ST BLE Sensor App, supporting BLE 4.2 or higher

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

Software and Other prerequisites

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

- **FP-AUD-BVLINWB1**
  - Download the <u>FP-AUD-BVLINKWB1</u> package from www.st.com, copy the .zip file contents into a folder on your PC. The package contains binaries and source code with project files (<u>Keil</u>, <u>IAR</u>, <u>STM32CubeIDE</u>) based on P-NUCLEO-WB55 or STM32WB5MM-DK.

- **ST BLE Sensor App** for Android or iOS, can be downloaded from relevant store,

- **Third party software for audio acquisition:**
  - <u>Audacity</u>® is free, open source, cross-platform software for recording and editing sounds. It is available for Windows®, Mac®, GNU/Linux®; and other operating systems

1 www.st.com/stm32ode

2

Select Function Pack:
FP-AUD-BVLINKWB1

3 Download & unpack

FP-AUD-BVLINKWB1 package structure

Name

- _htmresc
- Documentation
- Drivers
- Middlewares
- Projects
- Utilities
- package.xml
- Release_Notes.html

Docs

BSP, HAL drivers

BLE service, USB class, PDM2PCM lib, Opus

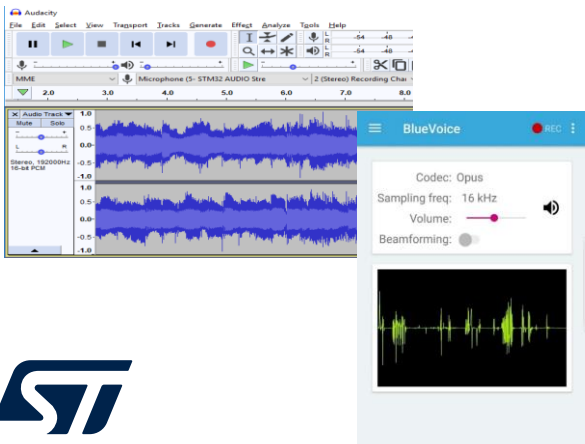BVLCentral
BVLPeripheral
BVLPeripheral_FullBand

4

6

Manage audio recording on your PC or mobile device

BlueVoice

Codec: Opus
Sampling freq: 16 kHz
Volume:
Beamforming:

Use the pre-compiled binaries or alternative re-compile the code

KEIL Tools by ARM

IAR SYSTEMS
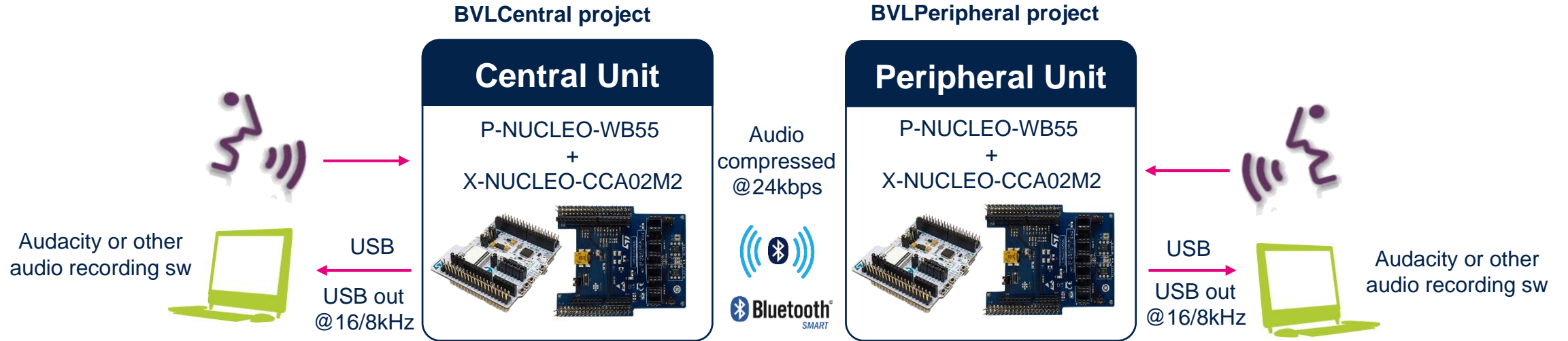
STM32 CubeIDE

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2.1- Test Full-Duplex audio streaming between two STM32WB

FP-AUD-BVLINKWB1. Step by step setup

HW prerequisites for Full-Duplex demo between two STM32WB

BVLCentral project

BVLPeripheral project

Central Unit

P-NUCLEO-WB55
+
X-NUCLEO-CCA02M2

Peripheral Unit

P-NUCLEO-WB55
+
X-NUCLEO-CCA02M2

Audio compressed @24kbps

Bluetooth SMART

Audacity or other audio recording sw

USB

USB out @16/8kHz

Audacity or other audio recording sw

USB

USB out @16/8kHz

OR

BVLCentral project

BVLPeripheral project

Central Unit

STM32WB5MM-DK

Peripheral Unit

STM32WB5MM-DK

Audio compressed @24kbps

Bluetooth SMART

Audacity or other audio recording sw

USB

USB out @16/8kHz

Audacity or other audio recording sw

USB

USB out @16/8kHz
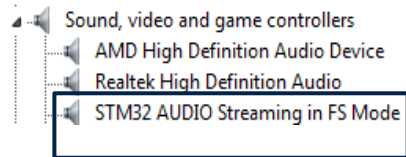
FP-AUD-BVLINKWB1. Step by step setup

Full-Duplex between two STM32WB demo setup

1 Compile and download BVLCentral application on one unit and BVLPeripheral application on the other (on P-NUCLEO-WB55 move JP1 on USB STL, on STM32WB5MM-DK move JP2 on USB STL)

2 Move JP1 on P-NUCLEO-WB55 or JP2 on STM32WB5MM-DK from USB STL to USB MCU. Plug a micro-USB cable into USB_USER

3 Both units are recognized as USB Microphone by Windows.

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 In Audacity set the default audio settings; open Edit/Preferences and select quality tab, choose 16 kHz as sampling frequency and 16-bit sample format. If you want to hear the audio while recording it, open Edit/Preferences, select Recording tab and check "Software playthrough of input". Now select the peripheral or central unit and click record *
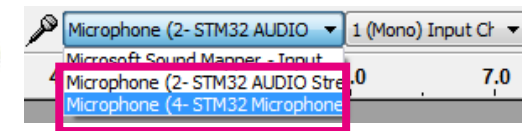
5 Press user button 1 on the board to START streaming, press again to STOP it. Both units can stream at the same time.

6 Audacity records audio coming from the selected microphone.
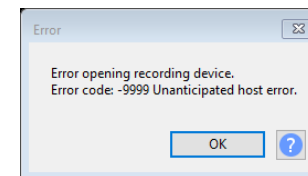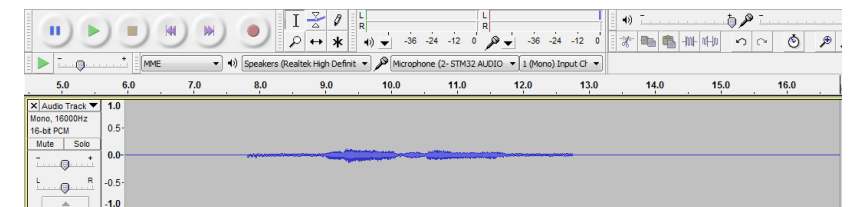
* In Windows 10, if an error occurs, please delete the audio driver from device manager and unplug and re-plug the usb cable from Nucleo board
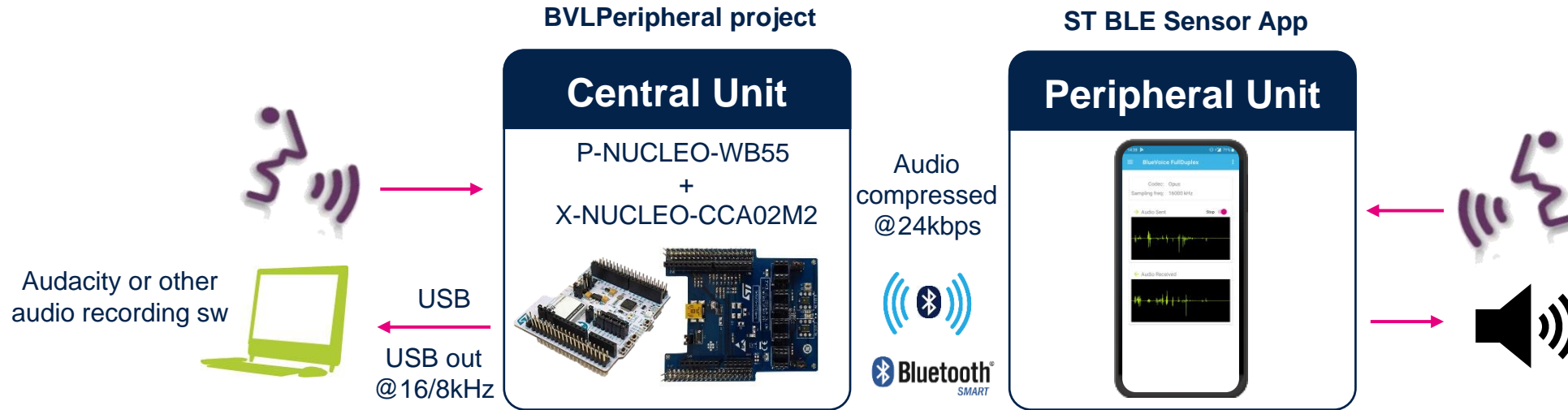
Error opening recording device.
Error code: -9999 Unanticipated host error.

OK

2.2- Test Full-Duplex audio streaming between STM32WB and mobile device
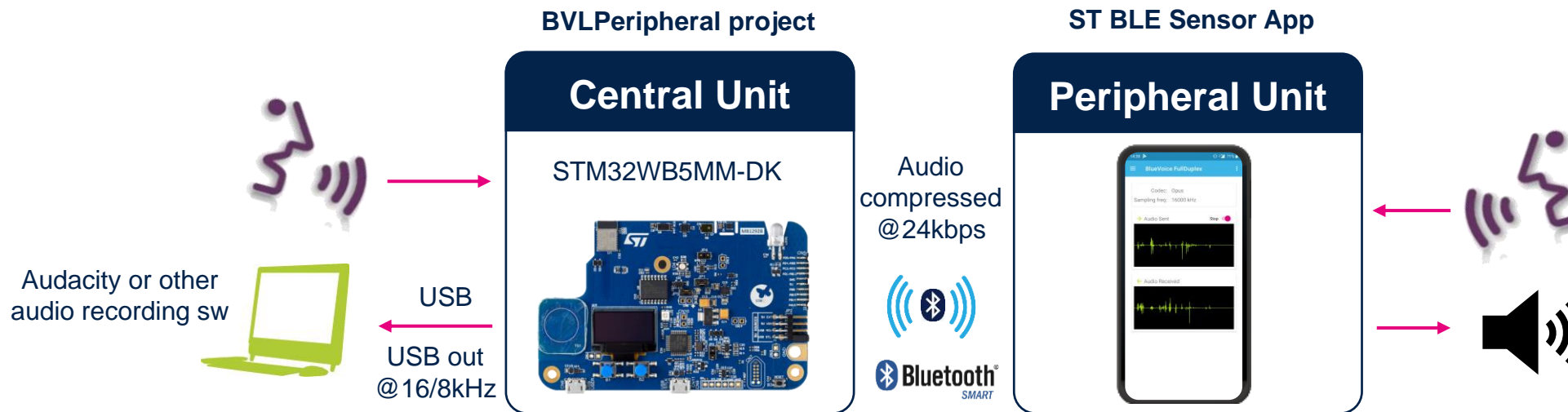
FP-AUD-BVLINKWB1. Step by step setup

HW prerequisites for Full-Duplex demo between STM32WB and mobile device
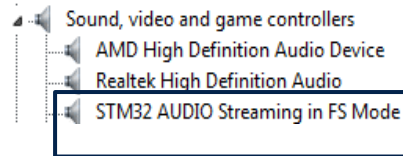
FP-AUD-BVLINKWB1. Step by step setup

Full-Duplex between STM32WB and mobile device demo setup

1 Compile and download BVLPeripheral application on P-NUCLEO-WB55 (JP1 on USB STL) or on STM32WB5MM-DK (JP2 on USB STL)

2 Move JP1 on P-NUCLEO-WB55 or JP2 on STM32WB5MM-DK from USB STL to USB MCU.
Plug a micro-USB cable into USB_USER

3 STM32WB is recognized as USB Microphone by Windows.

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

4 In Audacity set the default audio settings; open Edit/Preferences and select quality tab, choose 16 kHz as sampling frequency and 16-bit sample format. If you want to hear the audio while recording it, open Edit/Preferences, select Recording tab and check "Software playthrough of input". Now select the STM32Microphone and click record *
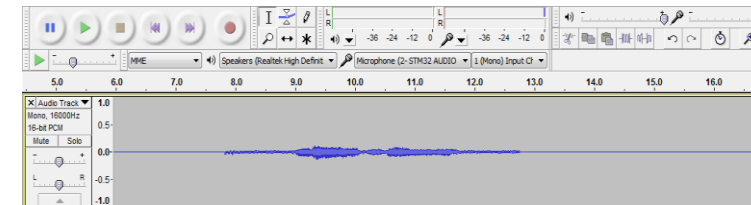
5 Open ST BLE Sensor App on your android device and connect to BVL-WB1.
Push User button 1 on the board to start audio streaming to the app.
You can hear audio from the smartphone speaker.

6 Enable the Start switch on the app to start audio streaming from the smartphone to the board. Audacity acquires the received audio. To avoid Larsen effect, keep the board and smartphone at minimum 40 cm or connect a headset to your mobile device.
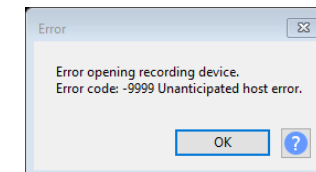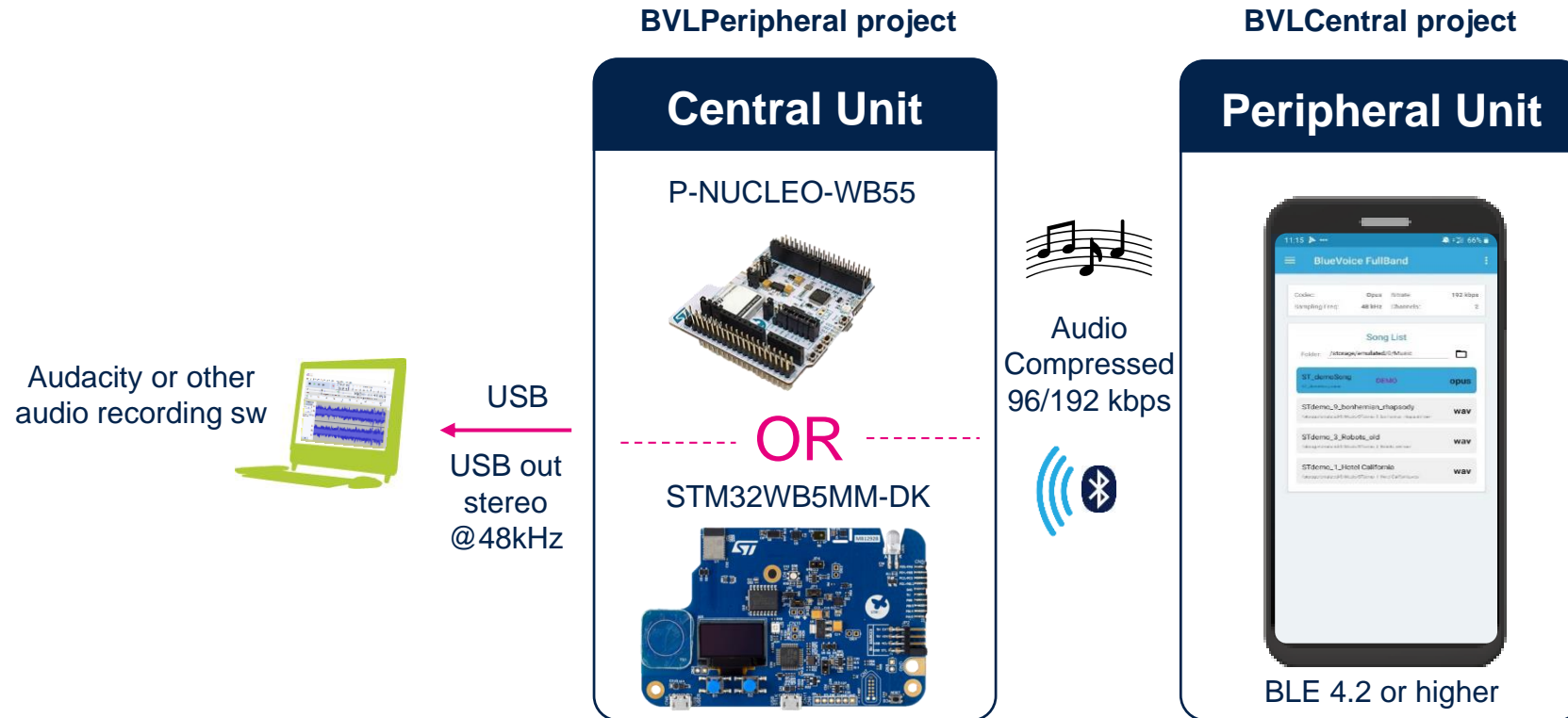
Error
Error opening recording device.
Error code: -9999 Unanticipated host error.
OK

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

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2.2- Test Full-Band stereo music streaming

FP-AUD-BVLINKWB1. Step by step setup

HW prerequisites for Full-Band stereo music streaming

BVLPeripheral project

BVLCentral project

Central Unit

P-NUCLEO-WB55

Audacity or other audio recording sw

USB

USB out stereo @48kHz

OR

STM32WB5MM-DK

Audio Compressed 96/192 kbps

Peripheral Unit

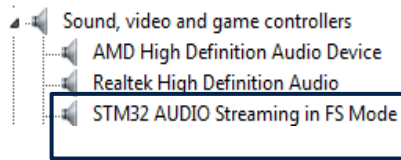BLE 4.2 or higher

FP-AUD-BVLINKWB1. Step by step setup
Full-Duplex between STM32WB and mobile device demo setup

1 Compile and download BVLPeripheral_FullBand application on P-NUCLEO-WB55 (JP1 on USB STL) or on STM32WB5MM-DK (JP2 on USB STL)

2 Move JP1 on P-NUCLEO-WB55 or JP2 on STM32WB5MM-DK from USB STL to USB MCU.
Plug a micro-USB cable into USB_USER

3 STM32WB is recognized as USB Microphone by Windows.

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

4 In Audacity set the default audio settings; open Edit/Preferences and select quality tab, choose 48 kHz as sampling frequency and 16-bit sample format. If you want to hear the audio while recording it, open Edit/Preferences, select Recording tab and check "Software playthrough of input". Now select the STM32Microphone and 2 Recording Channels and click record *
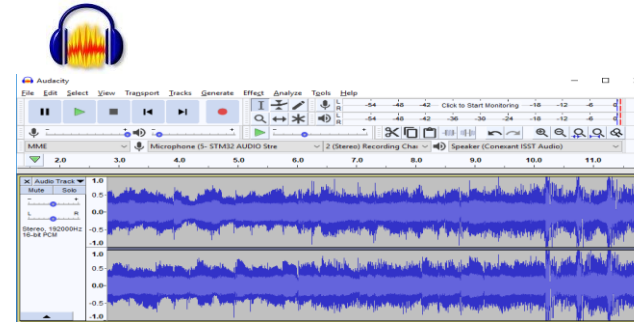
5 Open ST BLE Sensor App on your device and connect to BVFBAND. Choose a track and press play. (you can import wav file from your device)
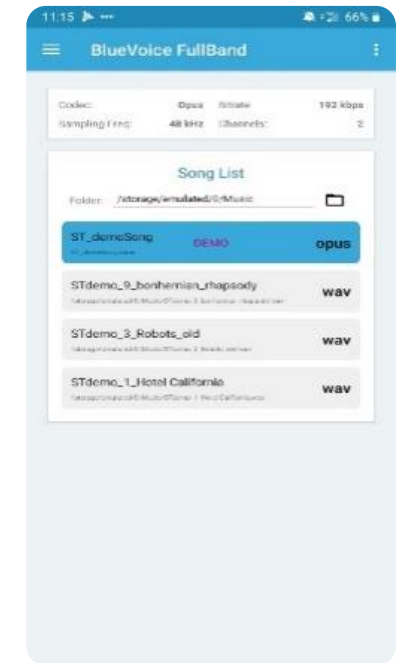
6 Audacity records 48kHz stereo music coming from the Android device.
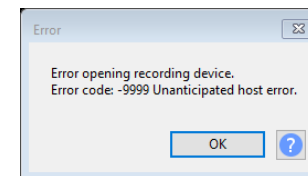
* In windows 10, if an error occurs, please delete the audio driver from device manager and unplug and re-plug the usb cable from Nucleo board

3- Documents & Related Resources

Documents & Related Resources

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**

P-NUCLEO-WB55:

- **Gerber files, BOM, Schematic**
- **DB3659**: STM32WB Nucleo-68 pack for wireless solutions – **data brief**
- **UM2435**: Bluetooth® Low Energy and 802.15.4 Nucleo pack based on STM32WB Series microcontrollers – **user manual**

STM32WB5MM-DK:

- **Gerber files, BOM, Schematic**
- **Data Brief:** available on www.st.com
- **User Manual:** available on www.st.com

X-NUCLEO-CCA02M2:

- **Gerber files, BOM, Schematic**
- **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
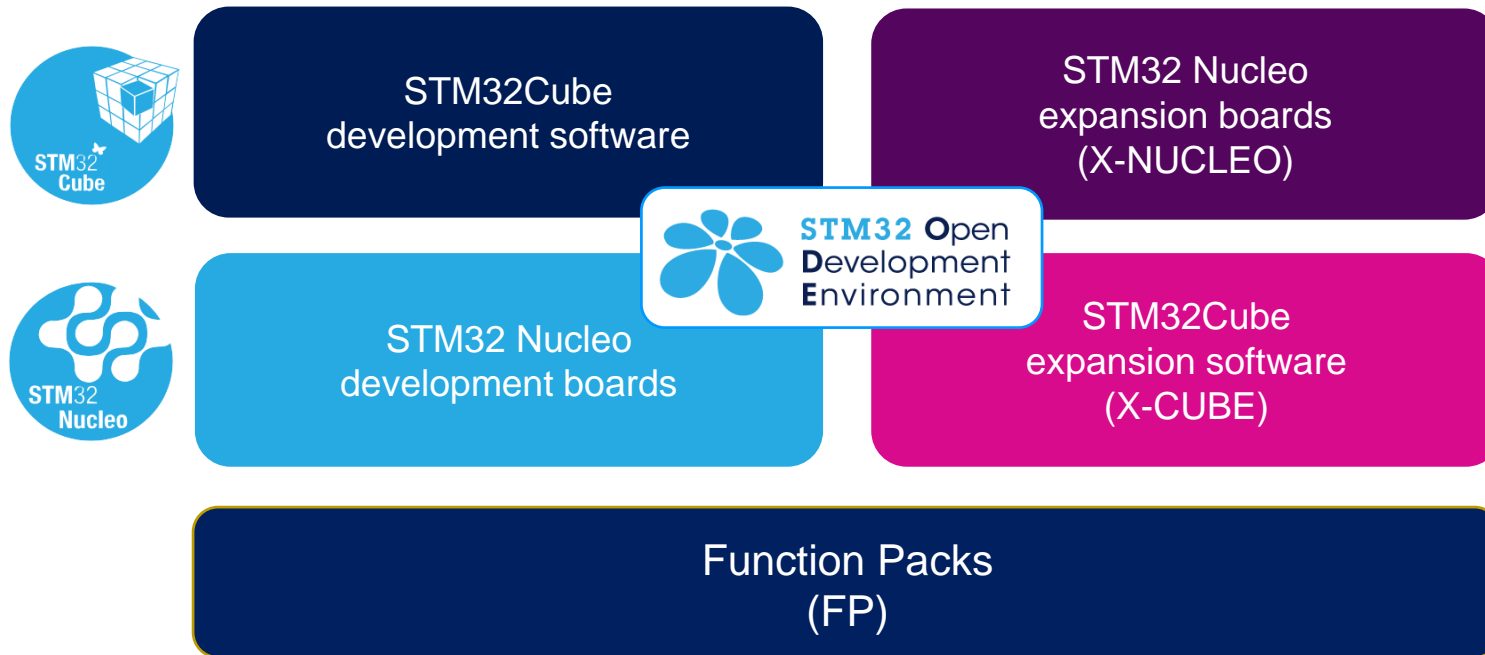
4- STM32 Open Development Environment: Overview

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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