Quick Start Guide

STM32Cube function pack for full-duplex voice streaming over Bluetooth low energy using Opus compression (FP-AUD-BVLINK2)
Quick Start Guide Contents

FP-AUD-BVLINK2: STM32Cube function pack for full-duplex voice streaming over Bluetooth low energy using Opus compression
Hardware and Software overview

Setup & Demo Examples
Documents & Related Resources

STM32 Open Development Environment: Overview
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 though 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
MEMS Microphones Expansion Board (CCA02M1)

Hardware Overview

Hardware Description

- The X-NUCLEO-CCA02M1 is an evaluation 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-MKI129Vx or STEVAL-MKI155Vx).

- 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.

Latest info available at [X-NUCLEO-CCA02M1](#)

Order Code: **X-NUCLEO-CCA02M1**
SensorTile Platform

Hardware Overview

STEVAL-STLKT01V1 Hardware Description

- STEVAL-STLKT01V1 is the development kit for the SensorTile board (STEVAL-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.

SensorTile Core System
STEVAL-STLCS01V1

SensorTile Cradle eXpansion
STEVAL-STLCX01V1

13.5mm

Antenna Clearance Area

MP34DT04

STM32L476

LSM6DSM

LSM303AGR

LPS22HB

BALF-NRG-01D3

BlueNRG-MS

SensorTile Cradle
STEVAL-STLCR01V1
**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.
FP-AUD-BVLINK2 Software

- FP-AUD-BVLINK2 is an STM32Cube function pack that performs voice streaming over BLE in a full-duplex configuration using the advanced Opus compression algorithm. The application runs on the STM32 Nucleo and includes drivers and middleware for BLE (BlueNRG-MS) and digital MEMS microphones.

- Sample implementation available for X-NUCLEO-IDB05A1 plus X-NUCLEO-CCA02M1 connected to a NUCLEO-F446RE or NUCLEO-L476RG, for SensorTile (STEVAL-STLKT01V1) and BlueCoin (STEVAL-BCNKT01V1)

Key features

- Complete firmware to implement full-duplex speech communication over Bluetooth low energy (BLE) using Opus compression

- 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 v1.2.1 (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 or jack connector

- Compatibility with ST BLE Sensor app (v 4.2.0 or higher), available for Android.

FP-AUD-BVLINK2 Software Overview

Overall Software Architecture

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Latest info available at FP-AUD-BVLINK2
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FP-AUD-BVLINK2: STM32Cube function pack for full-duplex voice streaming over Bluetooth low energy using Opus compression
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STM32 Open Development Environment: Overview
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 STM32 Nucleo, SensorTile or BlueCoin board, for a fast demo setup.

• **FP-AUD-BVLINK2 v1.0.1 or higher**
  - Copy the .zip file content into a folder on your PC. The package contains source code example (Keil, IAR, System Workbench) based on **NUCLEO-F446RE, NUCLEO-L476RG, SensorTile or BlueCoin**.

• **STBLESensor App** (v 4.2.0 or higher) for **Android** can be downloaded from Google Store.

• Third party software for audio acquisition (if you are using STM32Nucleo board)
  - **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](http://audacity.sourceforge.net)
Setup & Demo Examples
STM32Nucleo - System overview

Central Unit

STM32 Nucleo

Audio In Expansion*

BLE Expansion

Peripheral Unit

STM32 Nucleo

BLE Expansion

Audio In Expansion

Audio compressed @16kbps

USB out @16/8kHz

X-NUCLEO-CCA02M1
X-NUCLEO-IDB05A1

* Used for USB streaming

Full-Duplex

X-NUCLEO-IDB05A1
X-NUCLEO-CCA02M1
Setup & Demo Examples
STM32Nucleo - HW prerequisites

- 2x STM32 Nucleo Bluetooth Low Energy expansion board (X-NUCLEO-IBD05A1)
- 2x STM32 Nucleo MEMS Microphones expansion board (X-NUCLEO-CCA02M1)
- 2x STM32 Nucleo development board (NUCLEO-F446RE, NUCLEO-L476RG), for Full-Duplex communication.
- Alternately 1x STM32 Nucleo development board (NUCLEO-F446RE, NUCLEO-L476RG), for simplex communication with a mobile device.
- PC with Windows® 7 or above
- Android™ device running ST BLE Sensor app v4.2.0 or higher (for simplex streaming).
- 2x USB type A to Mini-B USB cable

2x kits needed
(for central and peripheral roles In full-duplex communication)
FP-AUD-BVLINK2
Voice over BLE software

1. www.st.com/stm32ode-fp

2. Select FP-AUD-BVLINK2

3. Download & unpack

FP-AUD-BVLINK2 package structure:
- Docs
- BSP, HAL and drivers
- BlueNRG, BlueVoice
- Application example

4. Build the application

Open project example "BVLCen" or "BVLPer"
1. Compile and download BVLCen application on one unit and BVLPer application on the other (see previous slide).

2. Unplug USB cable from STM32 Nucleo board.
   Move STM32 Nucleo jumper JP5 to E5V.
   Plug mini USB cable into X-NUCLEO-CCA02M1.

3. Both units are recognized as USB Microphone.

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

5. Press STM32Nucleo 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.
Setup & Demo Examples

SensorTile - System overview

Central Unit

SensorTile

STEVAL-STLCS01V1
+ STEVAL-STLCX01V1

Audio out @16/8kHz

Peripheral Unit

SensorTile

STEVAL-STLCS01V1
+ STEVAL-STLCX01V1

Audio compressed @16kbps

Full-Duplex
Setup & Demo Examples
SensorTile - HW prerequisites

• 2x STEVAL-STLKT01V1: STEVAL-STLCS01V1 connected to the STEVAL-STLCX01V1 for Full-Duplex communication.

• 2x Passive speaker output: loudspeaker or headset.

• Alternately, 1x STEVAL-STLKT01V1: STEVAL-STLCS01V1 connected to the STEVAL-STLCX01V1, for simplex communication with a mobile device.

• Android™ device running ST BLE Sensor app v4.2.0 or higher.

2x kits needed
(for central and peripheral roles)
Setup & Demo Examples
SensorTile - HW setup

• 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).
Setup & Demo Examples
SensorTile - Demo setup

1. Compile and download BVLCen application on one SensorTile and BVLPer application on the other.

2. Connect to the jack connector on the Expansion cradle board a loudspeaker or a headset.

3. Double tap on the SensorTile that must act as transmitter, the audio streaming will start.

4. Double tap again on the same unit to stop the streaming.

5. Both units can stream at the same time.
Setup & Demo Examples
BlueCoin - System overview

Central Unit
BlueCoin
STEVAL-BCNCS01V1
STEVAL-BCNST01V1

Peripheral Unit
BlueCoin
Audio compressed @16kbps
STEVAL-BCNCS01V1
STEVAL-BCNST01V1

Audio out @16/8kHz
Full-Duplex
Setup & Demo Examples
BlueCoin - HW prerequisites

- 2x STEVAL-BCNKT01V1: STEVAL-BCNCS01V1 connected to the STEVAL-BCNST01V1 for Full-Duplex communication.
- Passive speaker output: loudspeaker or headset.
- Alternately 1x STEVAL-BCNKT01V1: STEVAL-BCNCS01V1 connected to the STEVAL-BCNST01V1, for simplex communication with a mobile device.
- Android™ device running ST BLE Sensor app v4.2.0 or higher.
Setup & Demo Examples
BlueCoin - HW setup

- In order to program the board you need to connect an external ST-Link to the SWD connector on the BlueCoin Station, 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 BlueCoin 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 Station).
Compile and download BVLCen application on one BlueCoin and BVLPer application on the other.

Connect to the jack connector on the BlueCoin Station a loudspeaker or a headset.

Press the button indicated in the picture above to start the audio streaming from the BlueCoin acting as transmitter.

Press again the same button to stop the streaming.

Both units can stream at the same time.
FP-AUD-BVLINK2-Peripheral streams audio @16kHz, bitrate 16kbps.

When the BlueVoiceOPUS profile is enabled, the following functions are available (for further information refer to the UM of the ST BLE Sensor app):

• Play back the audio stream received from the ST device.
• Record and save the received audio.
• Web-based speech to text service in different languages.
Documents & Related Resources (1/2)

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

FP-AUD-BVLINK2:
- **DB3552**: STM32Cube function pack for full-duplex voice streaming over Bluetooth low energy using Opus compression – Data Brief
- **UM2382**: Getting started with the STM32Cube function pack for full-duplex voice streaming over Bluetooth low energy using Opus compression – 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

Consult www.st.com for the complete list
All documents are available in the DESIGN tab of the related products webpage

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 kit: augmented acoustics and motion sensing development platform – User Manual

Consult www.st.com for the complete list
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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.
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
- Integrated debugging and programming ST-LINK probe
- STM32 microcontroller
- 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.

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.

**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

**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

COLLECT

TRANSMIT

ACCESS

CREATE

POWER

PROCESS

Our answer

www.st.com/stm32ode