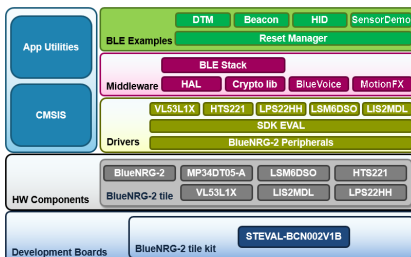# Software development kit for BlueTile, including sensor data streaming over BLE, HID peripheral and Beacon

Features

- BlueNRG-2 peripheral drivers
- BlueNRG-2 SDK software development kit
- BlueTile sensors drivers for LSM6DSO, LIS2MDL, LPS22HH, HTS221, VL53L1X and MP34DT05-A
- BLE software stack with HAL (hardware abstraction layer), and CryptoLib
- BlueVoice library to perform ADPCM compression and stream voice over BLE half-duplex
- MotionFX library to estimate spatial orientation through real-time motion-sensor data fusion
- BLE Reset Manager basic application to support firmware over-the-air (OTA) update
- BLE DTM (Direct Test Mode) application to enable real-time interaction between BlueNRG-2 and a dedicated graphical user interface STSW-BNRGUI
- BLE Beacon application to advertise programmable data
- BLE HID peripheral application to emulate HID devices such as a wireless keyboard or mouse
- BLE Sensor Demo application to enable real-time streaming of sensor data to the ST BLE Sensor app running on a smartphone

Description

The STSW-BLUETILE-DK extends the STSW-BLUENRG1-DK evaluation SW package for the BlueNRG-1 and BlueNRG-2 Bluetooth Low-Energy systems-on-chip by adding drivers for all sensors on the BlueTile kit, middleware libraries, and several BLE application examples.

One of the libraries in the package is the outstanding MotionFX library, which implements real-time motion-sensor data fusion through various sophisticated algorithms based on specific phenomena to estimate the orientation of an object in space. Another featured library is the BlueVoice library, which applies ADPCM compression on a PCM audio stream and then performs half-duplex (one-way) streaming of compressed data over a wireless BLE link.

The sample applications provide a very good starting point from which to develop your own applications with working code for typical BLE and sensor functionality. These applications include BLE Direct Test Mode for real-time interaction with the BlueNRG-2 wireless system-on-chip, BLE Beacon to enable the advertising of user-programmable data to multiple BLE devices, BLE HID Peripheral to emulate a wireless keyboard and a wireless mouse, and the BLE Sensor Demo for real-time streaming of sensor data to the ST BLE Sensor app running on an Android or iOS mobile device.

Product summary	
Software development kit for BlueTile	STSW-BLUETILE-DK
BlueNRG-1, BlueNRG-2 DK SW package	STSW-BLUENRG1-DK
Bluetooth LE enabled sensor node development kit	STEVAL-BCN002V1B
BLE sensor application for Android and iOS	ST BLE Sensor

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1 STSW-BLUETILE-DK software package overview

STSW-BLUETILE-DK package libraries and sample applications

The MotionFX library in the STSW-BLUETILE-DK software development kit is dedicated to real-time motion-sensor data fusion to estimate the orientation in space. The library computes quaternions and Euler angles based on data from the accelerometer, the gyroscope and the magnetometer. This library also includes gyroscope bias estimation and compensation, magnetometer hard-iron effects estimation and compensation, and accelerometer vibrations rejection. This library is also included in the X-CUBE-MEMS1 software expansion.

The BlueVoice library applies the ADPCM compression algorithm on the PCM audio stream coming from the digital microphone, and streams half-duplex (one-way) the compressed data over a wireless BLE link. This library is also included in the FP-AUD-BVLINK1 function pack.

The BLE Reset Manager is the basic BLE application that is executed when the system is powered. If there is a more recent firmware image stored in the Flash memory, it overwrites the old firmware image and then runs the user application. The newer firmware image can be downloaded from the ST BLE Sensor app running on a mobile device when the BLE Sensor Demo application is running on the BlueTile kit.

The BLE DTM (Direct Test Mode) application enables real-time interaction with the BlueNRG-2 wireless system-on-chip on the BlueTile. The corresponding dedicated graphical user interface is the PC application STSW-BNRGUI.

The BLE Beacon application enables the advertising of user-programmable data. All BLE devices will be able to receive this data without the need to establish a point-to-point connection.

The BLE HID Peripheral application enables the emulation of two HID devices: a wireless keyboard and a wireless mouse. In the first case, the BlueTile is plugged on its host motherboard and connected via USB to a normal keyboard, all key presses are then sent via BLE. In the second case, the gyroscope is exploited to control the mouse by rotating the BlueTile along the X or Y axis.

The BLE Sensor Demo application enables real-time streaming of sensor data to the ST BLE Sensor app running on the smartphone. The app let the user plot and log data from all BlueTile sensors, test the detection of accelerometer events embedded in the smart accelerometer, check the accuracy of the orientation estimated by the MotionFX library, verify the performance of voice streaming enabled by the BlueVoice library. The app also allows you to control the RGB LED on the BlueTile and supports the firmware over-the-air (OTA) update. This is the default application preloaded on the BlueTile for demo purposes.

Figure 1. **Screenshots of the ST BLE Sensor app when it is connected to the BlueTile running the BLE Sensor Demo application**
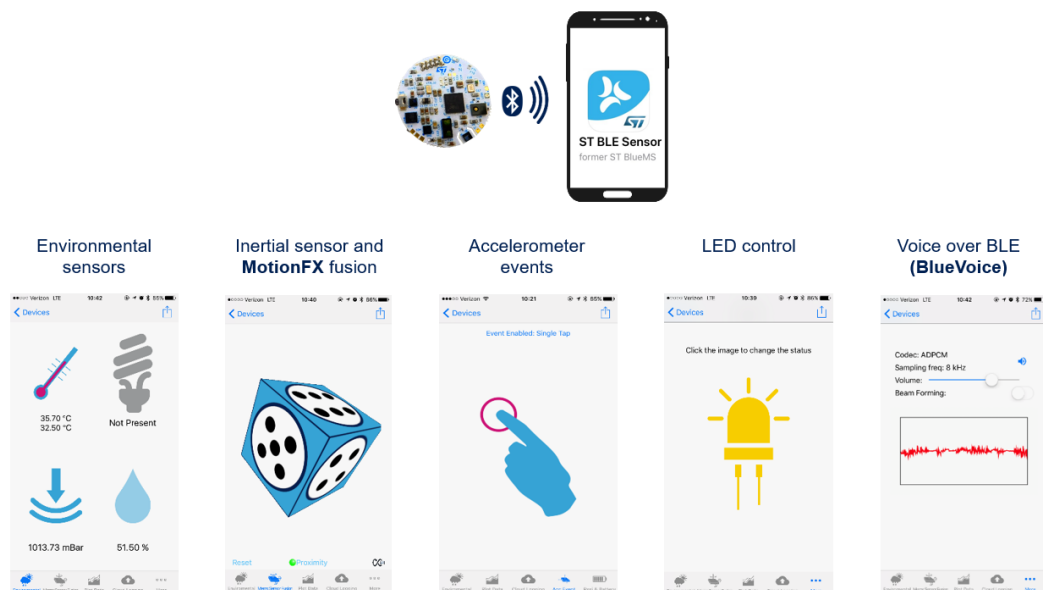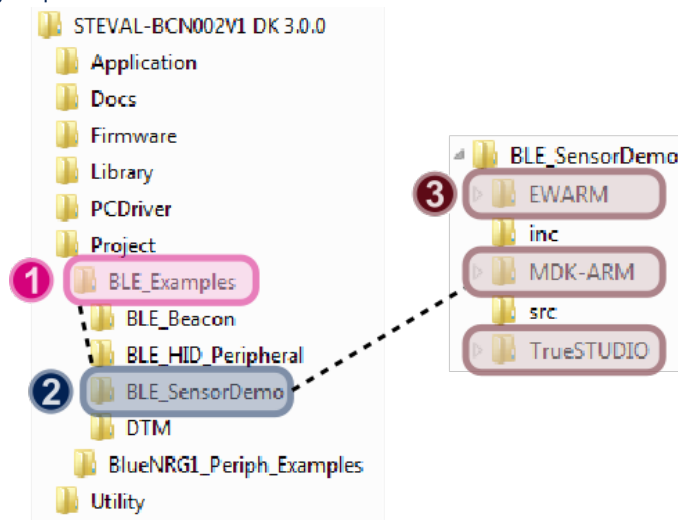
STSW-BLUETILE-DK package folder structure

The STSW-BLUETILE-DK is organized as follows:

- The "Application" folder is dedicated to PC applications such as the Wizard to generate the header file needed for the BLE radio initialization.
- The "Docs" folder is dedicated to the documentation.
- The "Firmware" folder contains pre-compiled firmware binaries (hex format) of all BLE example applications and all BlueNRG-2 peripheral examples.
- The "PCDriver" folder contains the Virtual COM port driver (not needed under Windows 10), also available for download as STSW-STM32102; and the DFU (device firmware update) utility needed to program the STM32L1 microcontroller on the host motherboard of the BlueTile, also available for download as STSW-STM32080.
- The "Project" folder contains two subfolders with project files for different IDEs: "EWARM" for IAR Embedded Workbench, "MDK-ARM" for Keil uVision, and "TrueSTUDIO" for Atollic:
  - the BlueNRG-2 peripheral examples folder
  - the BLE example application folder.
- The "Utility" folder which contains miscellaneous utilities, such as the Flasher utility needed by the IAR Embedded Workbench IDE.

Figure 2. SDK directory structure with examples and IDE project files

1. Expand the BLE_Examples folder
2. Choose an appropriate demo application (BLE_SensorDemo is the default demo firmware)
3. Open the project file for your preferred IDE

2 Memory mapping difference in versions above 1.1.0

The STSW-BLUETILE-DK firmware version 1.1.0 and above include an updated memory mapping; any migration from a previous version need an update of the Reset Manager firmware too. The following table show the difference of the memory mapping between version 1.1.0 and a previous one.

Figure 3. Firmware version comparison

The easiest way to update the firmware on the STEVAL-BCN002V1 is by using the daughter board connected to a PC, and with the *BlueNRG-1_2 Flasher – Utility v3.0.0* flash one of the precompiled firmware included in the development kit.

Precompiled **SensorDemo** firmware that includes the updated bootloader can be found in the folder:

`\Firmware\BLE_Examples\BLE_SensorDemo\BlueNRG-2`

Both the following firmware can be flashed to update the bootloader:

- BLE_SensorDemo_LowerApp_OTA (with OTA ResetManager).hex
- BLE_SensorDemo_Use_OTA_ServiceManager (with OTA ServiceManager).hex

Revision history

Table 1. Document revision history

Date	Version	Changes
15-Nov-2018	1	Initial release.
27-Jun-2019	2	Updated cover page Description and Product summary table
		Renamed (was Detailed description) and updated Section 1 STSW-BLUETILE-DK software package overview
		Added Section 2 Memory mapping difference in versions above 1.1.0

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