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# UM2071 User manual

# BlueNRG-1 development kit

## Introduction

The BlueNRG-1 is a low power Bluetooth® smart system on chip, compliant with the Bluetooth® v4.2 specification and supporting master, slave and simultaneous master-and-slave roles.

The following BlueNRG-1 kits are available:

1. BlueNRG-1 development platform (order code: STEVAL-IDB007V1)

The STEVAL-IDB007V1 also provides a set of hardware resources for a wide range of application scenarios: sensor data (accelerometer, pressure and temperature sensor), remote control (buttons and LEDs) and debug message management through USB virtual COM. Three power options are available (USB only, battery only and external power supply plus USB) for high application development and testing flexibility.



### Figure 1: STEVAL-IDB007V1 development platform

### Contents

Со	ntents							
1	Getting	started		7				
	1.1	1.1 Kit contents						
	1.2	System r	equirements	7				
	1.3	BlueNRG	i-1 development kit setup	7				
2	Hardwar	e descrip	otion	8				
	2.1	STEVAL	IDB007V1 board overview	8				
	2.2	BlueNRG	-1 SoC connections	9				
	2.3	Power su	ipply	11				
	2.4	Jumpers		12				
	2.5	Sensors.		12				
	2.6	Extensio	n connector	12				
	2.7	Push-buttons						
	2.8	JTAG connector						
	2.9	LEDs						
	2.10	STM32L151CBU6 microcontroller1						
	2.11	Current measurements						
	2.12	Hardware	e setup	13				
3	BlueNR	G-1 Navig	ator	14				
	3.1	BlueNRG	- -1 Navigator 'Demonstration Applications'	14				
		3.1.1	BlueNRG-1 Navigator 'Basic examples'	16				
		3.1.2	BlueNRG-1 Navigator 'BLE demonstration and test application	ıs'16				
		3.1.3	BlueNRG-1 Navigator 'Peripherals driver examples'	17				
	3.2	BlueNRG	i-1 Navigator 'Development Kits'	17				
		3.2.1	BlueNRG-1 Navigator 'Release Notes' and 'License'	18				
4	BlueNR	G-1 Flash	er utility	19				
	4.1	System r	equirements and installation	19				
	4.2	Main use	r interface window	19				
		4.2.1	Main menu items	20				
		4.2.2	Image file selection	20				
		4.2.3	'Image File' tab	21				
		4.2.4	Device Memory tab	21				
5	Drogram	4.2.3	b PluoNPC 1 ovotom on ohin	22				
J	Fiografi	ming wit	in Didening-i system on cmp	24				

|--|

57

	5.1	Software	directory structure	24
6	BlueNRG	i-1 beaco	n demonstration application	25
	6.1	BLE Beac	on application setup	25
		6.1.1	Initialization	25
		6.1.2	Define advertising data	25
		6.1.3	Entering non-connectable mode	25
7	BlueNRG	i-1 chat d	emo application	27
	7.1	Periphera	I and central device setup	27
		7.1.1	Initialization	27
		7.1.2	Add service and characteristics	28
		7.1.3	Enter connectable mode	28
		7.1.4	Connection with central device	28
8	BlueNRG	a-1 chat n	naster and slave demo application	30
	8.1	BlueNRG	1 chat master and slave roles	30
		8.1.1	Initialization	30
		8.1.2	Add service and characteristics	31
		8.1.3	Start discovery procedure	31
		8.1.4	Enter connectable mode	31
		8.1.5	Connection with chat master and slave client device	31
9	BlueNRG	i-1 remot	e control demo application	32
	9.1	BLE remo	te control application setup	32
		9.1.1	Initialization	32
		9.1.2	Define advertising data	33
		9.1.3	Add service and characteristics	33
		9.1.4	Connection with a BLE Central device	
10	BlueNRG	i-1 senso	r profile demo	34
	10.1	BlueNRG	app for smartphones	35
	10.2	BlueNRG	1 sensor profile demo: connection with a central de	evice 35
		10.2.1	Initialization	35
		10.2.2	Add service and characteristics	36
		10.2.3	Enter connectable mode	36
		10.2.4	Connection with central device	36
11	BlueNRG	i-1 senso	r profile central demo	37
12	BlueNRG	-1 HID/H	OGP demonstration application	38
	12.1	BLE HID/I	HOGP mouse demonstration application	38



Contents	UM2071
12.2 BLE HID/HOGP Keyboard demonstration application	38
13 BlueNRG-1 throughput demonstration application	
13.1 BLE unidirectional throughput scenario	39
13.2 BLE bidirectional throughput scenario	39
14 BLE notification consumer demonstration application	41
15 BlueNRG-1 peripheral driver examples	
15.1 ADC examples	42
15.2 GPIO examples	42
15.3 I <sup>2</sup> C examples	43
15.4 Micro examples	43
15.5 RTC examples	44
15.6 SPI examples	44
15.7 SysTick examples	45
15.8 Timers examples	45
15.9 UART examples	47
15.10 WDG examples	47
16 Schematic diagrams	
17 Revision history	

# List of tables

Table 1: STEVAL-IDB007V1 board component descriptions	9
Table 2: BlueNRG-1 pin description with board functions	9
Table 3: STEVAL-IDB007V1 kit platform power supply modes	11
Table 4: STEVAL-IDB007V1 kit platform jumpers	12
Table 5: BlueNRG-1 Beacon advertising manufacturing data	25
Table 6: Serial port configuration	27
Table 7: BLE remote advertising data	32
Table 8: Document revision history	55



# List of figures

Figure 1: STEVAL-IDB007V1 development platform	1
Figure 2: STEVAL-IDB007V1 board components	8
Figure 3: BlueNRG-1 Navigator	.14
Figure 4: BLE Beacon application	.15
Figure 5: BLE Beacon Flash programming	.15
Figure 6: BLE Beacon documentation	.16
Figure 7: Basic examples	.16
Figure 8: BLE demonstration and test applications	.17
Figure 9: Peripherals driver examples	.17
Figure 10: STEVAL-IDB007V1 Kit components	.18
Figure 11: BlueNRG-1 Flasher utility	.19
Figure 12: BlueNRG-1 Flasher utility main window	.20
Figure 13: BlueNRG-1 Flasher utility file selection	.21
Figure 14: BlueNRG-1 Flasher utility image file viewer	.21
Figure 15: BlueNRG-1 Flasher utility device memory viewer	.22
Figure 16: BlueNRG-1 Flasher utility changing memory fields	.22
Figure 17: BlueNRG-1 Flasher utility 'Comport Setting' popup	.23
Figure 18: BLE chat client	.29
Figure 19: BLE chat server	.29
Figure 20: BlueNRG-1 sensor demo GATT database	.34
Figure 21: BlueNRG sensor app	.35
Figure 22: STEVAL-IDB007V1 arduino connectors	.48
Figure 23: STEVAL-IDB007V1 JTAG	.48
Figure 24: STEVAL-IDB007V1 BlueNRG-1	.49
Figure 25: STEVAL-IDB007V1 power management, sensors	.50
Figure 26: STEVAL-IDB007V1 buttons and LEDs	.51
Figure 27: STEVAL-IDB007V1 micro	.52
Figure 28: STEVAL-IDB007V1 USB, level translator, JTAG for micro	.53
Figure 29: STEVAL-IDB007V1 EEPROM	.54



# 1 Getting started

### 1.1 Kit contents

The STEVAL-IDB007V1 kit includes:

- 1 BlueNRG-1 development platform
- 1 2.4 GHz Bluetooth antenna
- 1 USB cable

## 1.2 System requirements

The BlueNRG-1 Navigator and Flasher PC applications require:

- PC with Intel® or AMD® processor running one of the following Microsoft® operating systems:
  - Windows XP SP3
  - Windows Vista
  - Windows 7
- At least 128 MB of RAM
- USB ports
- At least 40 MB of available hard disk space
- Adobe Acrobat Reader 6.0 or later.

## 1.3 BlueNRG-1 development kit setup

After downloading the BlueNRG-1 DK software package (STSW-BLUENRG1-DK) from *www.st.com*, extract BlueNRG-1\_DK-x.x.x-Setup.zip contents to a temporary directory, launch BlueNRG-1-DK-x.x.x-Setup.exe and follow the on-screen instructions.



EWARM Compiler 7.70 or later is required for building the BlueNRG1\_DK\_x.x.x demonstration applications.



Keil MDK-ARM and Atollic-True Studio toolchains are also supported.



# 2 Hardware description

## 2.1 STEVAL-IDB007V1 board overview

The BlueNRG-1 board in the STEVAL-IDB007V1 development kit lets you experiment with BlueNRG-1 system on chip functions. It features:

- Bluetooth® SMART board based on the BlueNRG-1 Bluetooth low energy system on chip
- Associated BlueNRG-1 development kit SW package including firmware and documentation
- Up to +8 dBm available output power (at antenna connector)
- Excellent receiver sensitivity (-88 dBm)
- Very low power consumption: 7.7 mA RX and 8.3 mA TX at -2 dBm
- Bluetooth® low energy v4.2 compliant, supports master, slave and simultaneous master-and-slave roles
- Integrated balun which integrates a matching network and harmonics filter
- SMA connector for antenna or measuring equipment
- 3 user LEDs
- 2 user buttons
- 3D digital accelerometer and 3D digital gyroscope
- MEMS pressure sensor with embedded temperature sensor
- Battery holder
- JTAG debug connector
- USB to serial bridge for providing I/O channel with the BlueNRG-1 device
- Jumper for measuring current for BlueNRG-1 only
- RoHS compliant

The following figure and table describe physical sections of the board.

### Figure 2: STEVAL-IDB007V1 board components





Region	Description
А	BlueNRG-1 system on chip
С	Micro USB connector for power supply and I/O
0	JTAG connector
М	RESET button
Ν	two USER buttons
Н	LPS25HB MEMS pressure sensor with embedded temperature
Ι	LSM6DS3 3D digital accelerometer and 3D digital gyroscope
G	PWR LED
Р	three user LEDs
back of the PCB	battery holder for two AAA batteries
J, L	Two rows of Arduino-compliant connectors
S	Integrated balun with matching network and harmonics filter
Q	STM32L151CBU6 48-pin microcontroller (USB to serial bridge for I/O channel to PC communication) $^{(1)}$
R	ST2378E level translator to adapt voltage level between STM32 and BlueNRG-1

Table 1: STEVAL-IDB007V1 board component descriptions

### Notes:

<sup>(1)</sup>STM32 is not intended to be programmed by users

## 2.2 BlueNRG-1 SoC connections

The BlueNRG-1 very low power Bluetooth low energy (BLE) single-mode system on chip (*Figure 2: "STEVAL-IDB007V1 board components"* – region A) has 160 KB of Flash, 24 KB of RAM, a 32-bit core ARM cortex-M0 processor and several peripherals (ADC, GPIOs, I<sup>2</sup>C, SPI, Timers, UART, WDG and RTC).

The microcontroller is connected to various components such as buttons, LEDs and sensors. The following table describes the microcontroller pin functions.

		Board function									
Pin name	Pin	LED			Pressure sensor	3D accelerometer and gyroscope	JTAG	Arduino connectors			
	No		Micro	Button				CN1	CN2	CN3	CN4
DIO10	1						JTMS- SWTDIO				
DIO9	2						JTCK- SWTCK				
DIO8	3		TXD (PA2)					pin 1 IO8		pin 2 TX	

Table 2: BlueNRG-1 pin description with board functions



### Hardware description

		Board function									
Pin name	Pin	LED			Dressure	accelerometer and gyroscope	JTAG	Arduino connectors			
	NO		Micro	Button	sensor			CN1	CN2	CN3	CN4
DIO7	4	DL2						pin 2 IO9			pin 6 SCL
DIO6	5	DL1								pin 7 IO6	pin 5 SDA
VBAT3	6										
DIO5	7				SDA PUSH2 button			pin 9 SDA			
DIO4	8				SCL			pin 10 SCL			
DIO3	9					SDO/SA0		pin 5 MISO		pin 6 IO5	
DIO2	10					SDA		pin 4 MOSI		pin 5 IO4	
DIO1	11					CS	JTAG- TDO	pin 3 CS			
DIO0	12					SCL	JTAG- TDI	pin 6 SCK		pin 4 IO3	
ANATEST0/DIO14	13	DL3									pin 4 AD3
ANATEST1	14										
ANATEST2	15										
ANATEST3	16										
FXTAL1	17										
FXTAL0	18										
VBAT2	19										
RF1	20										
RF0	21										
SXTAL1	22										
SXTAL0	23										
VBAT1	24										
RESET	25		RESET	RESET			RESET		pin 3 NRST	pin 8 IO7	
SMPSFILT1	26										
SMPSFILT2	27										

DocID029370 Rev 3



### UM2071

### Hardware description

	Pin	Board function									
Pin name						3D		Arduino connectors			
	No	LED	Micro	Button	sensor	accelerometer and gyroscope	JTAG	CN1	CN2	CN3	CN4
VDD1V2	28										
DIO13	29			PUSH1							pin 3 AD2
DIO12	30					INT1					pin 1 AD0
FTEST	31										
DIO11	32		RXD PA3							pin 1 RX pin 3 IO2	pin 2 AD1

The board section labeled BLUENRG-1 (*Figure 2: "STEVAL-IDB007V1 board components"* – region B) includes the following main components:

- BlueNRG-1 low power system on chip (in a QFN32 package)
- High frequency 16 MHz crystal
- Low frequency 32 kHz crystal for the lowest power consumption
- Integrated balun which integrates a matching network and harmonics filter
- SMA connector

For more details, see Figure 24: "STEVAL-IDB007V1 BlueNRG-1"

### 2.3 Power supply

Green LED DL4 (*Figure 2: "STEVAL-IDB007V1 board components"* – region G) signals the board is being powered, either via:

- micro USB connector CN5 (*Figure 2: "STEVAL-IDB007V1 board components"* region C)
- two AAA batteries (region F)
- an external DC power supply plus micro USB connector

The following table describes the power supply modes available on the STEVAL-IDB007V1 board and corresponding jumper settings.

Power supply mode	JP1	JP2	Comment
1 - USB	Fitted: 1-2	Fitted: 2- 3	USB supply through connector CN5 ( <i>Figure 2: "STEVAL-IDB007V1 board components"</i> – region C)
2 - Battery	Fitted: 2-3	Fitted: 1- 2	The supply voltage must be provided through battery pins (region F).
3 - Combo	Fitted: 1-2	Optional	USB supply through connector CN5 for STM32L1; JP2 pin 2 external power for BlueNRG-1

Table 3. STEVAL -IDB007V1	kit nlatform	nower eu	only n	aahar
Table 3: STEVAL-IDDUU/VI	KIL platform	power su	opiv n	loaes



### 2.4 Jumpers

The following jumpers are available:

Table 4: STEVAL-IDB007V1 kit platform jumpers

Jumper	Description
JP1	1-2: to provide power from USB (JP2: 2-3) 2-3: to provide power from battery holder (JP2: 1-2)
JP2	<ul><li>1-2: to provide power from battery holder (JP1: 2-3)</li><li>2-3: to provide power from USB (JP1: 1-2)</li><li>JP2 pin 2 to VDD to provide external power supply to BlueNRG-1 (JP1: 1-2)</li></ul>
JP3	pin 1 and 2 UART RX and TX of MCU pin 3 GND
JP4	Fitted: to provide VBLUE to BlueNRG-1. It can be used also for current measurement.
JP5	Fitted: TEST pin to VBLUE Not fitted: TEST pin to GND

### 2.5 Sensors

The following sensors are available on the platform:

- An LPS25HB (*Figure 2: "STEVAL-IDB007V1 board components"* region H) is a piezoresistive absolute pressure sensor which functions as a digital output barometer. The device comprises a sensing element and an IC interface which communicates through I<sup>2</sup>C from the sensing element to the application.
- 2. An LSM6DS3 3D (region I) digital accelerometer and 3D digital gyroscope with embedded temperature sensor which communicates via SPI interface. One line for interrupt is also connected.

## 2.6 Extension connector

BlueNRG-1 signal test points are shared on two Arduino-compliant connector rows: CN1, CN3 (*Figure 2: "STEVAL-IDB007V1 board components"* – region J) and CN2, CN4 (region L). See *Table 2: "BlueNRG-1 pin description with board functions"*.

### 2.7 Push-buttons

The board has one user button to reset the microcontroller (*Figure 2: "STEVAL-IDB007V1 board components*" – region M) and two further buttons for application purposes (region N).

## 2.8 JTAG connector

A JTAG connector (*Figure 2: "STEVAL-IDB007V1 board components"* – region O) allows BlueNRG-1 microcontroller programming and debugging with an in-circuit debugger and programmer such as ST-LINK/V2.



Only SWD mode is supported



### 2.9 LEDs

LEDs DL1 (yellow), DL2 (red), DL3 (blue) and DL4 (green, power LED) are available on the board (*Figure 2: "STEVAL-IDB007V1 board components"* – regions G and P).

### 2.10 STM32L151CBU6 microcontroller

The most important feature of the STM32L151CBU6 48-pin microcontroller (*Figure 2: "STEVAL-IDB007V1 board components"* – regions Q) is the USB to serial bridge providing an I/O channel with the BlueNRG-1 device.

The microcontroller is connected to the BlueNRG-1 device through an ST2378E level translator (region R).



The STM32L microcontroller on the board is not intended to be programmed by users. ST provides a pre-programmed firmware image for the sole purpose of interfacing BlueNRG-1 to a USB host device (e.g., a PC).

## 2.11 Current measurements

To monitor the power consumption of the BlueNRG-1 only, remove the jumper from JP4 and insert an ammeter between pins 1 and 2 of the connector (when the power is ON, remove the USB connection).

Since power consumption of the BlueNRG-1 is usually very low, an accurate instrument in the range of few micro amps is recommended.

### 2.12 Hardware setup

- 1. Connect an antenna to the SMA connector
- 2. Configure the board to USB power supply mode as per the jumper settings in *Table 3:* "STEVAL-IDB007V1 kit platform power supply modes"
- 3. Connect the board to a PC via USB cable (connector CN5)
- 4. Verify the power indication LED DL4 is on.



# 3 BlueNRG-1 Navigator

BlueNRG-1 Navigator is a user friendly GUI which lets you select and run demonstration applications easily, without requiring any extra hardware. With it, you can access the following BlueNRG-1 DK software package components:

- BlueNRG-1 Bluetooth low energy (BLE) demonstration applications
- BlueNRG-1 peripheral driver examples
- BlueNRG-1 development kits
- release notes
- license files

With BlueNRG-1 DK Navigator, you can directly download and run the selected prebuilt application binary image (BLE examples or peripheral driver example) on the BlueNRG-1 platform without a JTAG interface.

The interface gives demo descriptions and access to board configurations and source code if needed.

You can run the utility through the BlueNRG-1 Navigator icon under: Start  $\rightarrow$  STMicroelectronics  $\rightarrow$  BlueNRG -1 DK X.X.X  $\rightarrow$  BlueNRG-1 Navigator

# <text><text><text><text><text><text><text><text><text><text>

### Figure 3: BlueNRG-1 Navigator

3.1 BlueNRG-1 Navigator 'Demonstration Applications'

You can navigate the menus for the reference/demo application you want to launch. For each application, the following information is provided:

- Application settings (if applicable)
- Application description
- Application hardware related information (e.g., LED signals, jumper configurations, etc.)

The following functions are also available for each application:

• **Flash**: to automatically download and run the available prebuilt binary file to a BlueNRG-1 platform connected to a PC USB port.

DocID029370 Rev 3



14/56

- **Doc**: to display application documentation (html format)
- **Project**: to open the project folder with application headers, source and project files.

The figure below shows you how to run the BLE Beacon demo application; the other demos function similarly.



Figure 4: BLE Beacon application

When a BlueNRG-1 platform is connected to your PC USB port, you can press the "Flash & Run" tab on the selected application window to download and run the available prebuilt application binary image on the BlueNRG-1 platform.



Figure 5: BLE Beacon Flash programming

Selecting the "Doc" tab opens the relative html documentation.



DocID029370 Rev 3

Figure 6: BLE Beacon documentation
BlueNRG-1 DK: BLE examples
lin nagreented Montrage Montes Tax
All Mark
BLE_Beacon_main.c File Reference
The sa RLE becomes that shows how to configure a DevMRG-1 server in order to advective specific manufacturing data and allow another BLE device to involve the sample of the Date/MRG-1 bases review. It also provides a reference example advective samp the RLE Over-The-Art (OTA) Server's Manufort Three support capability. Non .
Dotte the assume scale of these files
Detailed Description
This is a 9.12 back more thal back how to configure a BacHRS-1 back is indertise specific manufacturing data and also another BLE back to loss #16.1 the samp of the BacHRS-1 back back is a referred a interface example about how using the RLE back to another back is a referred as a
ATOLLIC project
To use the project with AFOLINC TransFUDIO for ARMI, please failow the instructions below
1. Open the ADULC TurbuTCO to Advance Turburger. Properties 2. Source Trading Properties To messages 2. Source Trading Properties 3. Source Turburg Properties 3
KEIL project
To use the project with K2II, viviend 5 to ABM, please failow the antinctions below:
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3. Dec (Things) - Documents in the first transport of the first

### 3.1.1 BlueNRG-1 Navigator 'Basic examples'

This page lists some basic sample applications for the BlueNRG-1 device to verify that BlueNRG-1 device is alive as well as the device sleep and wakeup modes.



3.1.2 BlueNRG-1 Navigator 'BLE demonstration and test applications'

This page lists all the available Bluetooth low energy (BLE) demonstration applications in the BlueNRG-1 DK software package. These applications provide usage examples of the BLE stack features for the BlueNRG-1 device.





Figure 8: BLE demonstration and test applications

### 3.1.3 BlueNRG-1 Navigator 'Peripherals driver examples'

This page lists the available BlueNRG-1 peripherals and corresponding test applications to work with certain features specific to the selected BlueNRG-1 peripheral.





# 3.2 BlueNRG-1 Navigator 'Development Kits'

This window displays the available BlueNRG-1 DK Kit platforms and corresponding resources. When you hovers the mouse pointer over a specific item, the related component is highlighted on the board.



DocID029370 Rev 3

### **BlueNRG-1** Navigator

### Figure 10: STEVAL-IDB007V1 Kit components



### 3.2.1 BlueNRG-1 Navigator 'Release Notes' and 'License'

As their name suggests, these pages display the BlueNRG-1 DK SW package Release Notes (html format) and the BlueNRG-1 DK software package license file, respectively.



### UM2071

# 4 BlueNRG-1 Flasher utility

The BlueNRG-1 Flasher utility allows BlueNRG-1 programming using the UART bootloader.

### 4.1 System requirements and installation

The BlueNRG-1 Flasher utility PC configuration requires the following minimum characteristics

- A PC with USB port running Windows® XP or Windows® 7
- 256 MB RAM
- 30 MB free hard disk space

You can run this utility by clicking on the BlueNRG-1 Flasher icon under: Start  $\rightarrow$  STMicroelectronics  $\rightarrow$  BlueNRG -1 DK X.X.X  $\rightarrow$  BlueNRG1 Flasher

le Tools Hel	p				
Select file No	file selected				
ash from	(10040000		1		
t				Elach	Maco or
<i></i>				1 10511	
			<u>[v]</u> ∪p	odate memory table	verity
Device Memory	Image File				
Start Address	0x10040000		<b>Size</b> 0x3000		Read
0	1	2	3	4	<u>.</u>
4 Write	III		Dea	ding memory	196

Figure 11: BlueNRG-1 Flasher utility

## 4.2 Main user interface window

In the upper section of the BlueNRG-1 Flasher - Utility main window, you can:

- select the image file ('Select file' button)
- choose the flashing address ('Flash from' text input bar, only enabled for .bin files)
- select the COM port to be used to interface the device ('Port' dropdown list)



DocID029370 Rev 3

### BlueNRG-1 Flasher utility

The BlueNRG-1 device memory is read when the associated COM port is opened.

ile Tools	Help	)																	
Select file	Not	file s	elect	ed															
lash from	l0x:	1004	10000	200   (							-								
ort	CO	M19	(ST I	DK)		_					•	Ť.		Flash	1			íass e	erase
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Device Memo	ory	In	iage l	File															
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		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		*
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0x10040050	)	D5	E2	04	10	6F	CE	04	10	D7	E2	04	10	7B	CE	04	10	Õā	
0x10040060	) (	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
0x10040070	) (	00	00	00	00	7D	CE	04	10	7F	CE	04	10	81	CE	04	10	}]	
0x10040080	) (	00	00	00	00	71	CE	04	10	73	CE	04	10	75	CE	04	10	q	
0x10040090	) 7	77	CE	04	10	79	CE	04	10	00	00	00	00	83	CE	04	10	wÎ	
0x100400A	0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		-
٠ .			17.				111	1			1/		1					×.	

### 4.2.1 Main menu items

From the 'File' menu, you can:

- Load an existing .bin or .hex (Intel extended) file.
- Save the current memory image in a .bin file. The start address and the size of the memory section to be saved to file are selectable from the 'Device Memory' tab.
- Close the application.

From the 'Tools' menu, you can mass erase all the device Flash memory.

### 4.2.2 Image file selection

Use the 'Select file' button on the main page (or the File>Load menu) to load an existing .bin or .hex file. The full path of the selected file appears next to the button and the 'Flash' becomes active.



Figure	13.	RIveNRG-1	Flasher	utility	file selection	n
riguie	13.	Diueinnu-i	Flashel	utility		

Select file Flash from	C:/Workspaces/BlueNRG-1/Binary/BLE_Chat_Server.bin		
Port	COM40 (ST DK)	Flash	Mass erase
		✓ Update memory table	Verify
			0%

By default, the 'Mass erase' option beside the 'Flash' button is not checked, and only the required memory pages are erased and written with the file content. When this option is checked, the memory flash phase is preceded by a full mass erase.

The 'Verify' option forces a check to ensure that the memory content has been written correctly.

Check the 'Update memory table' option to update the 'Device Memory' table after the flashing operation. This option is automatically checked when the 'Verify' checkbox is selected.

### 4.2.3 'Image File' tab

The selected file name, size and parsed contents to be flashed to device memory can be viewed in the 'Image File' tab.

Figure 14: BlueNRG-1 Flasher utility image file viewer

Device Memory	Ir	nage l	-ile																		
ile:				BLE_Chat_Server.bin Size:											54544 Bytes						
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	ASCII				
0x1005AB00	04	DA	0C	99	89	07	01	D4	85	20	61	EO	0D	99	08	60	Ú Ôaà "				
0x1005AB10	0E	98	05	60	3F	27	16	98	01	68	49	1E	39	43	49	1C	"?' hI9CI				
0x1005AB20	01	60	06	AA	28	00	FF	F7	4B	FE	15	9E	00	28	0E	D1	°°(ÿ÷Kþ (Ñ				
0x1005AB30	0C	98	40	07	0B	D5	01	2C	09	DB	64	10	16	98	00	68	@Ö,Ûd h				
0x1005AB40	40	10	16	99	08	60	76	10	08	99	81	42	F3	DB	16	98	@ `v BóÛ				
0x1005AB50	00	68	08	99	88	42	08	DA	40	1E	07	43	79	1C	16	98	h₿Ú@ Cy				
0x1005AB60	01	60	06	AA	28	00	FF	F7	2B	FE	08	98	B0	42	2E	DB	°ª(ÿ÷+þ °B.Ů				
0x1005AB70	80	21	C9	00	88	42	2A	DB	02	9E	76	1E	68	46	01	7E	!É B*Û v hF ~				
0x1005AB80	08	98	C0	B2	FF	F7	5F	FE	72	B6	13	48	00	7A	0D	EO	À²ÿ+_þr'l H				
0x1005AB90	44	49	09	18	50	31	0A	78	02	9B	5A	43	0A	70	0A	7A	DI P1 x ZC p z	-			
0x1005ABA0	02	9B	5A	43	92	19	0A	72	08	49	08	5C	08	28	EF	D1	ZC r1∖(iÑ				
0x1005ABB0	03	98	05	60	62	B6	07	98	80	11	17	99	08	60	08	98	"b¶				
0x1005ABC0	80	11	16	99	08	60	14	98	04	60	00	20	00	EO	86	20	• · à				

### 4.2.4 'Device Memory' tab

Select this tab to view the memory contents of a connected device.



tart Address	0x1	.0040	000						Si	ze (	)x3000	D				R	ead	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	-	-
x10040000	00	60	00	20	25	E8	04	10	89	E7	04	10	8B	E7	04	10	19	-
x10040010	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
0x10040020	00	00	00	00	00	00	00	00	00	00	00	00	8D	E7	04	10		
0x10040030	00	00	00	00	00	00	00	00	00	00	00	00	8F	E7	04	10		
0x10040040	97	E7	04	10	00	00	00	00	00	00	00	00	00	00	00	00	ç	
0x10040050	99	E7	04	10	00	00	00	00	A1	E7	04	10	00	00	00	00	ç	
0x10040060	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
0x10040070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
0x10040080	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
0x10040090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
0x100400A0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		Ļ
•						n	1										Þ	

Click the 'Read' button to transfer the memory segment defined by 'Start Address and 'Size' into the table.

The first column gives the base address of the following 16 bytes in a row (e.g., row 0x10040050, column 4 holds the hexadecimal byte value at 0x10040054.

You can change byte values by double-clicking a cell and entering a new hexadecimal value; edited bytes appear in red.

Click the 'Write' button to flash the entire page with the new byte values into device memory.

0x10040040	97	E7	04	10	00	00	00	00	00	00	00	00
0x10040050	99	E7	04	14	00	00	00	00	A1	E7	04	10
0x10040060	00	00	00	00	00	00	00	00	00	00	00	00

Figure 16: BlueNRG-1 Flasher utility changing memory fields

### 4.2.5 Using BlueNRG-1 Flasher utility with other boards

The BlueNRG-1 Flasher – Utility automatically detects BlueNRG-1 evaluation boards like STEVAL-IDB007V1 and uses an auxiliary STM32 to (driven by the GUI) to reset the BlueNRG-1 and put it into bootloader mode.

The application also works with custom boards providing simple UART access to the BlueNRG-1 device, but you must put the device in bootloader mode manually. Upon the selection of any non-STEVAL COM port, the following popup appears.



Figure 17: BlueNRG-1 Flasher utility 'Comport Setting' popup



When this popup appears, set the BlueNRG-1 pin DIO7 high and reset the BlueNRG-1 device (keeping the DIO7 high); the device should now be in bootloader mode.

You can also set a preferred Baudrate for the UART in the popup window and then press OK to return to the GUI.



Avoid resetting the device while using the BlueNRG-1 Flasher utility unless the Comport Setting popup is active. If the device is reset, you must toggle the COM port to use the Flasher utility again.



# 5 Programming with BlueNRG-1 system on chip

The BlueNRG-1 Bluetooth low energy (BLE) stack is provided as a binary library. A set of APIs to control BLE functionality. Some callbacks are also provided for user applications to handle BLE stack events. The user is simply requested to link this binary library to his or her application and use the relevant APIs to access BLE functions and complete the stack event callbacks to manage responses according to application requirements.

A set of software driver APIs is also included for accessing the BlueNRG-1 SoC peripherals and resources (ADC, GPIO, I<sup>2</sup>C, MFTX, Micro, RTC, SPI, SysTick, UART and WDG).

The development kit software includes sample code demonstrating how to configure BluenRG-1 and use the device peripherals and BLE APIs and event callbacks. Documentation on the BLE APIs, callbacks, and peripheral drivers are provided in separate documents.

# 5.1 Software directory structure

The BlueNRG-DK software package files are organized in the following directories:

- Application: containing BlueNRG-1 Navigator and Flasher PC applications.
- Doc: with doxygen BLE APIs and events, BlueNRG-1 peripheral drivers, BLE demo applications, BlueNRG-1 Peripheral examples, BlueNRG-1 SDK and HAL driver documentation, DK release notes and license file.
- **Firmware**: with prebuilt binary BLE and peripheral driver sample applications.
- Library
  - Bluetooth LE: Bluetooth low energy stack binary library and all the definitions of stack APIs, stack events callbacks and constants. Over-the-air Bluetooth low energy firmware upgrade support.
  - BlueNRG1\_Periph\_Driver: BlueNRG-1 drivers for device peripherals (ADC, clock, DMA, Flash, GPIO, I<sup>2</sup>C, timers, RTC, SPI, UARR and watchdog).
  - **CMSIS**: BlueNRG-1 CMSIS files.
  - SDK\_Eval\_BlueNRG1: SDK drivers providing an API interface to the BlueNRG-1 platform hardware resources (LEDs, buttons, sensors, I/O channel).
  - HAL: Hardware abstraction level APIs for abstracting certain BlueNRG-1 hardware features (sleep modes, clock based on SysTick, etc.).
- Project
  - **BLE\_Examples**: Bluetooth low energy demonstration application including Headers, source files and EWARM, Keil and Atollic project files.
  - BlueNRG1\_Periph\_Examples: with sample applications for the BlueNRG-1 peripherals and hardware resources, including Headers, source files and project files.
- Utility: contains some utilities



# 6 BlueNRG-1 beacon demonstration application

The BlueNRG-1 beacon demo is supported by the BlueNRG-1 development platform (STEVAL-IDB007V1). It demonstrates how to configure a BlueNRG-1 device to advertise specific manufacturing data and allow another BLE device to determine whether it is in BlueNRG-1 BLE beacon device range.

### 6.1 BLE Beacon application setup

This section describes how to configure a BlueNRG-1 device to act as a beacon device.

### 6.1.1 Initialization

The BlueNRG-1 BLE stack must be correctly initialized thus:

```
aci_gatt_init();
```

```
aci gap init(GAP PERIPHERAL ROLE, 0, 0x08, &service handle, &dev name char handle,
&appearance_char_handle);
```

See the BlueNRG-1 BLE stack documentation for more information on these and following commands.

### 6.1.2 Define advertising data

The BLE Beacon application advertises the following manufacturing data:

Data field	Description	Notes
Company identifier code	SIG company identifier <sup>(1)</sup>	Default is 0x0030 (STMicroelectronics)
ID	Beacon ID	Fixed value
Location UUID	Beacons UUID	Used to distinguish specific beacons from others
Major number	Identifier for a group of beacons	Used to group a related set of beacons
Minor number	Identifier for a single beacon	Used to identify a single beacon
Tx Power	2's complement of the Tx power	Used to establish how far you are from device

Table 5: BlueNRG-1 Beacon advertising manufacturing data

### Notes:

<sup>(1)</sup>available at: https://www.bluetooth.org/en-us/specification/assigned-numbers/company-identifiers

### 6.1.3 Entering non-connectable mode

The BLE Beacon device uses the GAP API command to enter non-connectable mode thus:

aci\_gap\_set\_discoverable(ADV\_NONCONN\_IND, 160, 160, PUBLIC\_ADDR,

NO\_WHITE\_LIST\_USE,0, NULL, 0, NULL, 0, 0);

To advertise the specific selected manufacturer data, the BLE Beacon application can use the following GAP APIs:

/\* Remove TX power level field from the advertising data: it is necessary to
have enough space for the beacon manufacturing data \*/

aci\_gap\_delete\_ad\_type(AD\_TYPE\_TX\_POWER\_LEVEL);

