Bluetooth Low Energy (BlueNRG)

life.augmented

What is Bluetooth® SMART (Low Energy)

Bluetooth® SMART is the latest enhancement of Bluetooth standard (V4.0), ultra-low power technology.

- Bluetooth® **SMART** enables **devices with coin cell batteries to be wirelessly connected**

- Bluetooth® **SMART** devices are used in a wide range of sensor applications transmitting small amounts of data.
  - **Automotive**
  - **Sport and fitness**
  - **Healthcare**
  - **Entertainment**
  - **Home automation**
  - **Security and proximity**

life.augmented

The Bluetooth® SMART Marks Overview

- Ultra low power consumption being a pure low energy implementation
- Months to years of lifetime on a standard coin cell battery

- Classic Bluetooth + Bluetooth low energy on a single chip (small price delta)
- These are the hub devices of the Bluetooth ecosystem

Source : Bluetooth® SIG

Bluetooth SMART vs Classic Bluetooth®

Feature	Bluetooth® Classic Mode	Bluetooth® Low energy Mode
Power Consumption Range	Between 1mA and 30mA	Between 1µA and 15mA
Over the air data rate	1–3 Mbit/s	1 Mbit/s
Range (typical)	30 m	50 m
Max TX power	+20 dBm (class 1) +4 dBm (class 2)	+10 dBm
RF Channels	79	40
Connection Time	100 ms	3 ms
Max packet Size	2875 µs = 1021 Bytes	328 µs = 27 Bytes
Encryption	Safer+	AES-128

Lower data-rate + Shorter connection time + less channels + smaller packet size

➔ Bluetooth Smart® aims at saving current consumption !

BlueNRG BLE Solution

SINGLE MODE BLUETOOTH® SMART WIRELESS NETWORK PROCESSOR

Integration

- 2.4GHz RF transceiver
- Cortex-M0 microcontroller (running the BT Single Mode protocol)
- AES 128-bit co-processor

Flexibility

- Master and Slave Single Mode BLE (4.0) Network Processor.
- On chip non-volatile Flash memory allows OTA BLE-stack upgrade. Stack qualified.

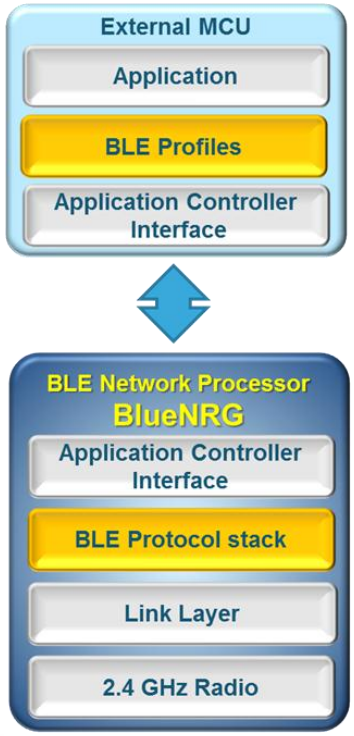
Low power

BEST IN CLASS

- I_{CC}RX 7.3mA
- I_{CC}TX 8.2mA @ 0 dBm
- I_{CC}Sleep 1.7µA
- I_{CC}Shutdown 2.5nA

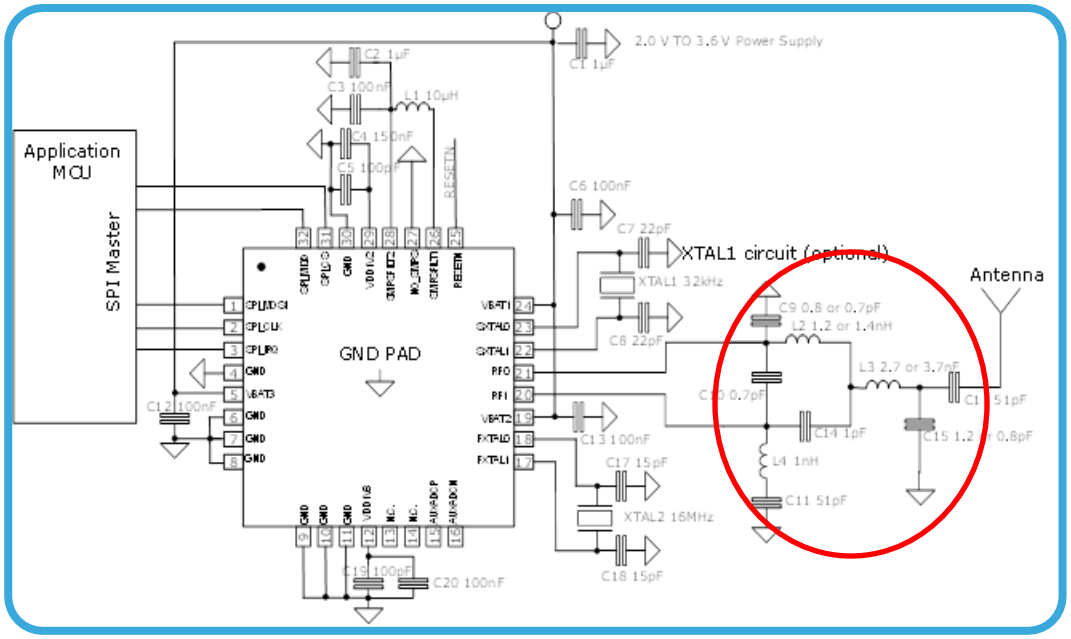
Small size

- QFN32: 5x5x1mm
- Flip chip: 2.66x2.56x0.56mm



life.augmented

BlueNRG Application schematic



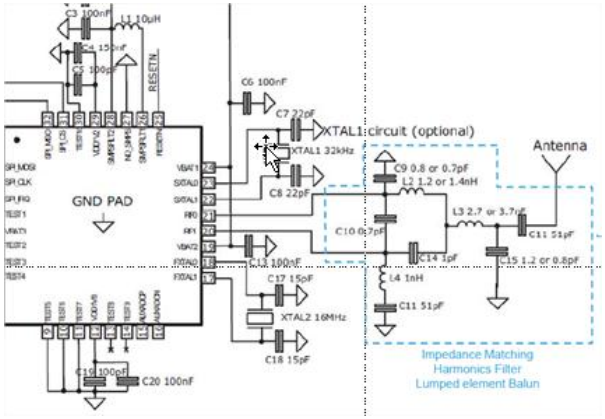
Component	High performance Mode	Standard Mode
C9	**0.8pF**	**0.7pF**
C10	0.7pF	0.7pF
C11	51pF	51pF
C14	1pF	1pF
C15	**1.2pF**	**0.8pF**
C16	51pF	51pF
L2	**1.2nH**	**1.4nH**
L3	**2.7nH**	**3.7nH**
L4	1nH	1nH

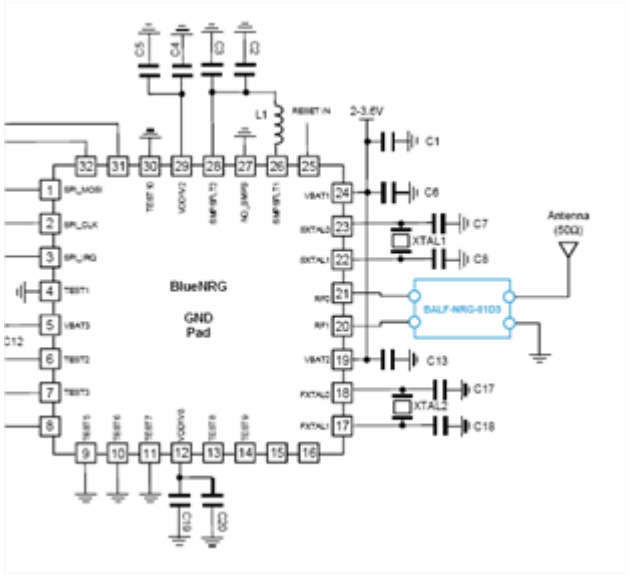
High Performance or **Standard Mode selectable through BOM**

- **High Performance :** TX output power up to +8dBm
- **Standard Mode** : TX output power up to +5dBm

BlueNRG can be routed on a single layer PCB further reducing costs

BALUN companion chip for BlueNRG

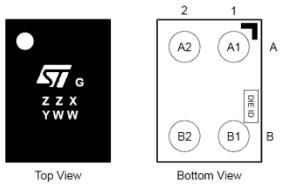




9 external components into 1 die

1.19mm²

- ST IPD Technology on glass
- High space saving
- Faster Time to market
- High Reliability
- High performance RF solution
  - No temperature dispersion, parasitic elements



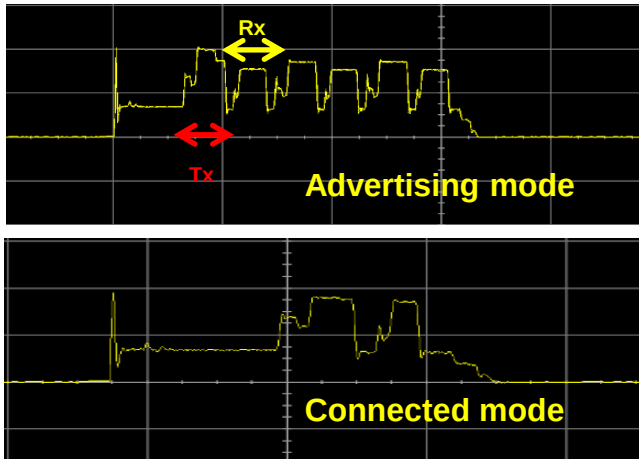
1.4x0.85x0.65

BALF-NRG-01D3 (for QFN)
BALF-NRG-02D3 (for WCSP)

life.augmented

BlueNRG avg current consumption

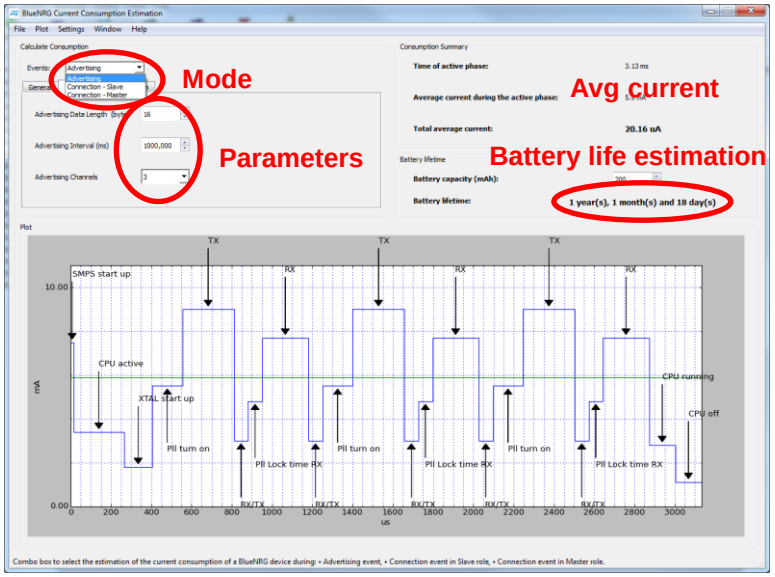
- *Average current consumption measured for various use-cases*



Vin=3.3V - Slave Mode - 32KHz XOSC - - Pout 2dBm

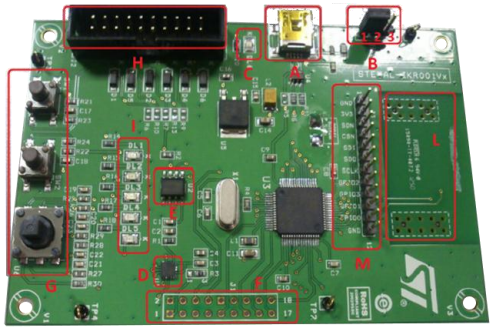
Test Item	Measured Result	Comment
Advertising (16 Bytes advertising data)	16 µA (1.28s interval) 38 µA (500ms interval)	All advertising channels, with data (e.g. name, power level, flag)
Connected No Data – Slave	5,4 µA (1.28s interval) 11 µA (500ms interval)	
Connected 1 packet for each event.	6,6 µA (1.28s interval, 19B data) 14 µA (500ms interval, 19B data)	Current due to communication with external micro is included

- *PC tool for current estimation*
  - Excellent correlation with real measurements
  - User-friendly, easy to parameterize
  - Inputs
    - Modes : Advertising / Connected as slave or Master
    - General settings (power / Payload / Intervals)
  - Outputs :
    - Average current
    - Battery life estimation
  - **STSW-BNRG001**



BlueNRG Evaluation kit hardware

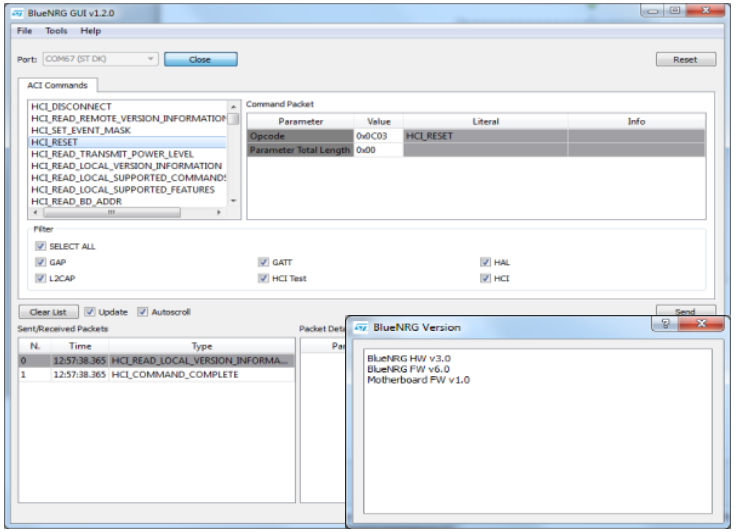
- *ST proposes a complete development kit including*
  - **Motherboard :**
    - STM32L1 µController
    - Mini USB (A) / JTAG
    - 1 user button, 1 joystick (G)
    - Accelerometer (LIS3DH)
    - Temperature sensor (STLM75)
    - 5 user LEDs (I)
    - AAA battery holder
  - **Daughter Board**
    - BlueNRG Bluetooth smart network processor
    - 16MHz Crystal, an Low power 32KHz
    - Balun, matching and SMA connector
  - **PC GUI**
    - Perform RF test/HCI commands/connection tests
    - Unitary test of commands
- *Evaluation kit provided with*
  - Accelerometer F/W example loaded (IDB002V1)
  - IAR project example (require an ST-Link device)



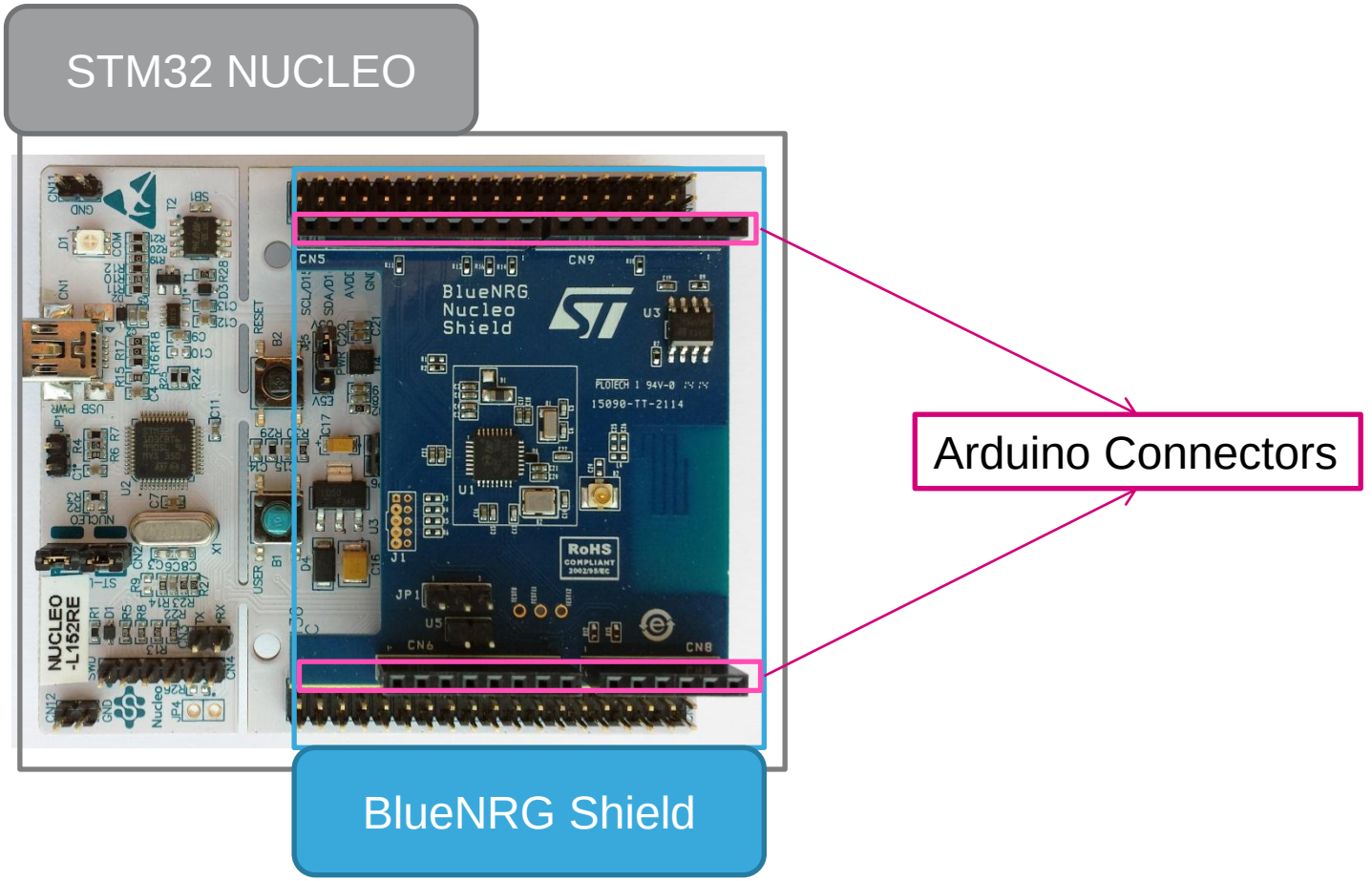
Full kit
STEVAL-IDB002V1

NEW !

USB Dongle
STEVAL-IDB003V1



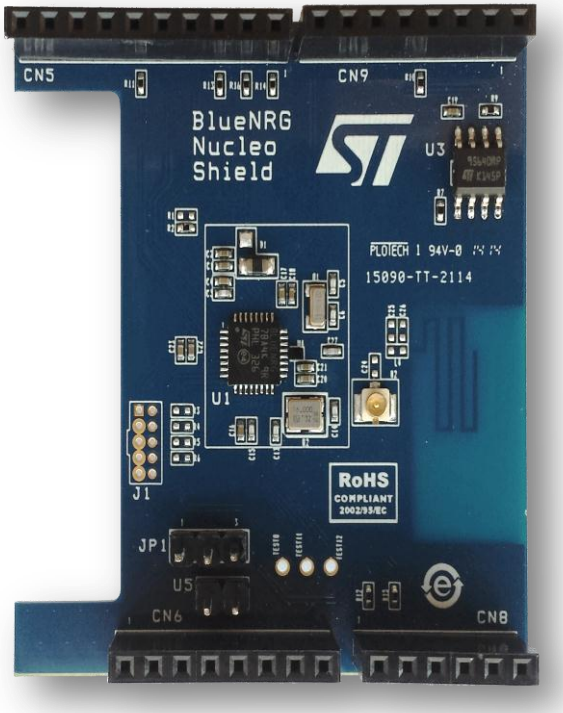
STM32 Nucleo and BlueNRG Shield



X-NUCLEO-IDB04A1

BlueNRG Shield
X-NUCLEO-IDB04A1

- **FEATURES:**
  - Ultra-low-power Bluetooth low-energy connectivity
  - **Compatible with both STM32-Nucleo** and **Arduino** development kits
  - **Self-consistent RF design** (includes antenna, balun filter, etc.)
  - SPI communication interface with host MCU
- **OUT-OF-THE-BOX:**
  - **Ready-to-use shield-plugin for RF BLE connectivity**
  - Application examples, quick starting guide and tutorials under dev.
- **SOFTWARE DEVELOPMENT KIT (SDK):**
  - **Extensive examples (source-code)** and API documentation
  - Support both ACI and HCI control interfaces over SPI
  - **Growing library of BLE profiles**
  - Full support for STM32-Nucleo/Cube development environment
- **BENEFITS:**
  - Fast prototyping of user applications, **start hands-on coding in 1-day**
  - **No Bluetooth connectivity or RF specialist required**

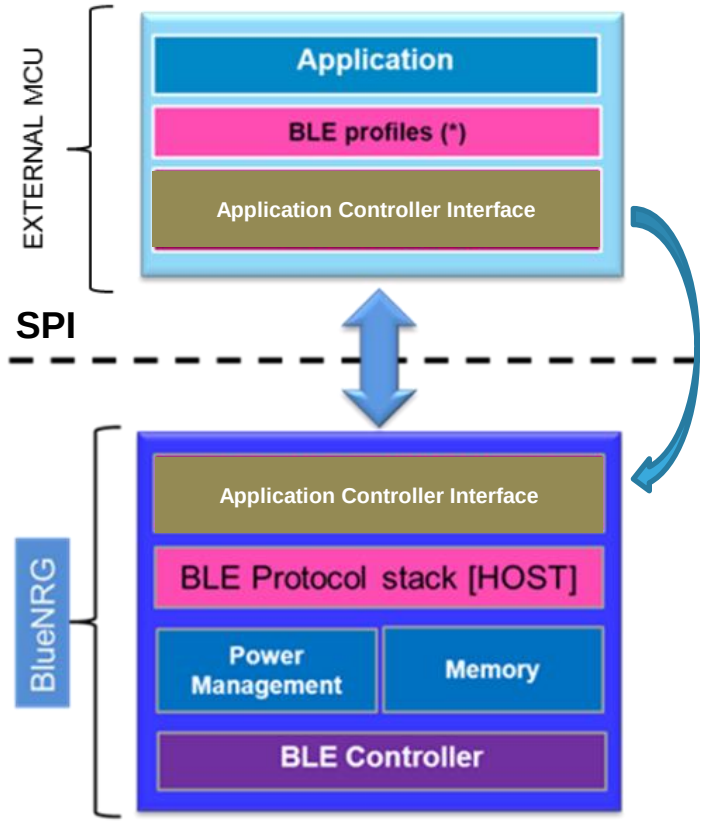


X-NUCLEO-IDB04A1

http://www.st.com/web/en/catalog/tools/PF260517

life.augmented

BlueNRG Software partitioning



- *BlueNRG embeds all the Bluetooth® Smart protocol stack*
- *Only the application remains in the host MCU.*

Application Controller Interface links BlueNRG with the Host MCU through SPI bus.

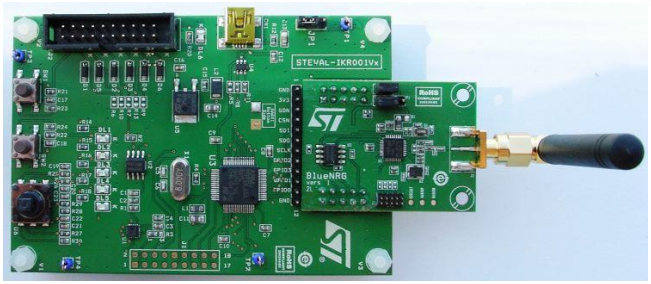
*BLE standard profiles are not mandatory

- ST can provide example of proprietary application

Clear SW partitioning between BlueNRG and Host MCU

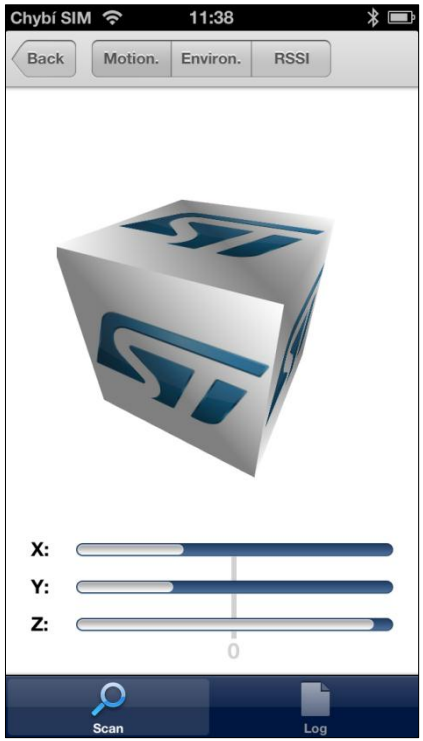
STEVAL-IDB002V1 Bluetooth Smart + Sensors demo

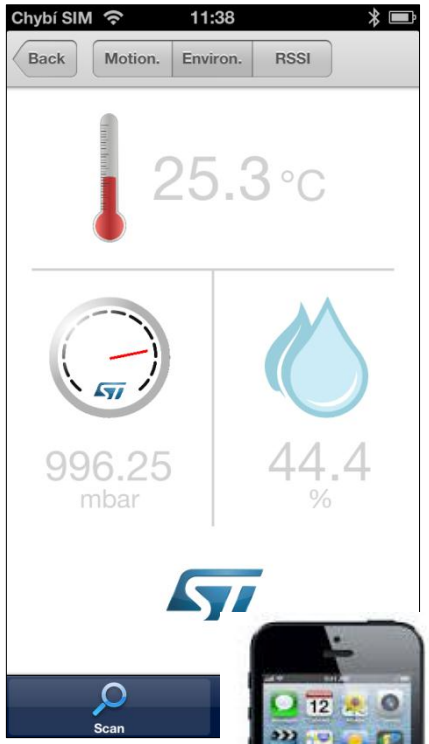
Bluetooth® 4.0 low-energy chip



STEVAL-IDB002V1

Android and iOS apps available on-line



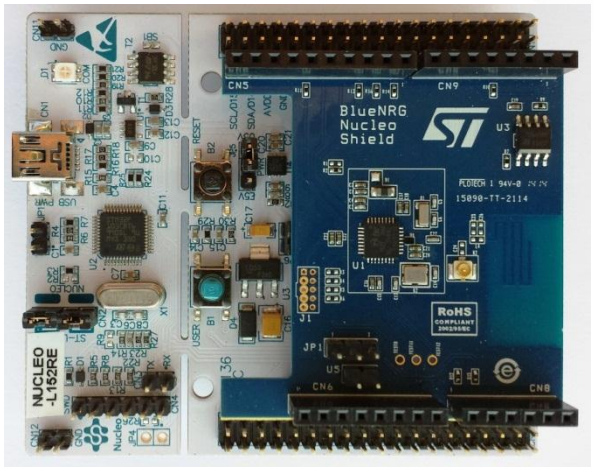


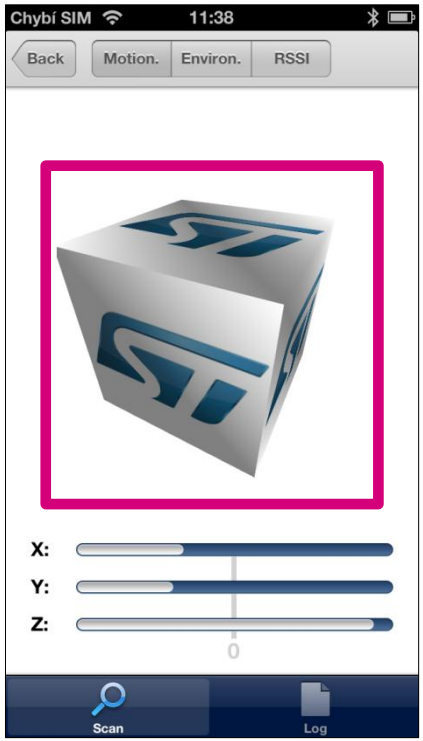
Sensors
- LPS25H Barometer
- HTS221 Humidity Sensor
- LIS3DH Accelerometer

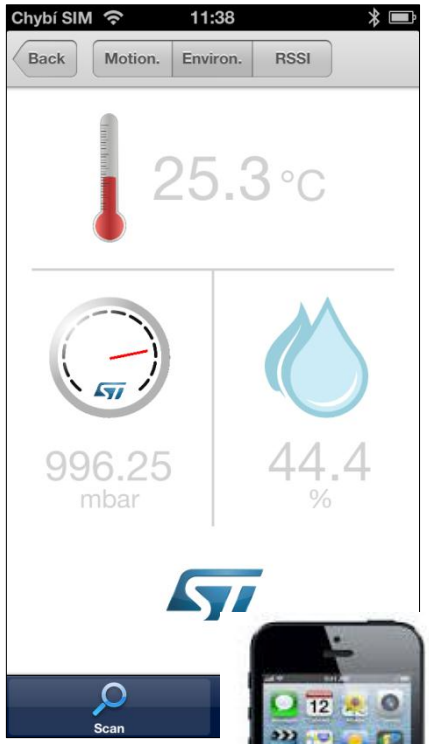
life.augmented

STM32L1 Nucleo - Bluetooth Smart + Sensors demo adaptation

Bluetooth® 4.0 low-energy chip







Cube spinning start / stop controlled by button on STM32L1 Nucleo
All sensor data are SIMULATED only

life.augmented


life.augmented