

# **BLUETOOTH SMART**

GETTING STARTED

Wednesday, 2 October 2013

Version 1.7



**Copyright © 2001 - 2013 Bluegiga Technologies**

Bluegiga Technologies reserves the right to alter the hardware, software, and/or specifications detailed herein at any time without notice, and does not make any commitment to update the information contained herein. Bluegiga Technologies assumes no responsibility for any errors which may appear in this manual. Bluegiga Technologies' products are not authorized for use as critical components in life support devices or systems.

Bluegiga Access Server, Access Point, APx4, AX4, BSM, iWRAP, BGScript and WRAP THOR are trademarks of Bluegiga Technologies.

The *Bluetooth* trademark and logo are registered trademarks and are owned by the Bluetooth SIG, Inc.

ARM and ARM9 are trademarks of ARM Ltd.

Linux is a trademark of Linus Torvalds.

All other trademarks listed herein belong to their respective owners.

# Table of Contents

|       |  |    |
|-------|--|----|
| 1     | Introduction   | 4  |
| 2     | What is Bluetooth Smart                                    | 5  |
| 2.1   | Classic Bluetooth vs. Bluetooth low energy                 | 6  |
| 2.2   | Backwards Compatibility                                    | 7  |
| 2.3   | Bluetooth Smart branding                                   | 8  |
| 2.3.1 | Compatibility  | 8  |
| 2.4   | More Information about the Technology                      | 10 |
| 3     | Bluegiga's Bluetooth Smart Products                        | 11 |
| 3.1   | BLE112 - Bluetooth Smart Module                            | 11 |
| 3.1.1 | Description  | 11 |
| 3.1.2 | Key features   | 11 |
| 3.1.3 | Benefits   | 12 |
| 3.2   | BLED112 - Bluetooth Smart USB Dongle                       | 13 |
| 3.2.1 | Description  | 13 |
| 3.2.2 | Key features   | 13 |
| 3.2.3 | Benefits   | 14 |
| 3.3   | BLE113 - Bluetooth Smart Module                            | 15 |
| 3.3.1 | Description  | 15 |
| 3.3.2 | Key features   | 15 |
| 3.3.3 | Benefits   | 16 |
| 3.4   | DKBLE112 and DKBLE113 - BLE112 and BLE113 Development Kits | 17 |
| 3.5   | Bluetooth Smart Software                                   | 18 |
| 3.5.1 | The Bluetooth Smart Stack                                  | 18 |
| 3.5.2 | The Bluetooth Smart SDK                                    | 18 |
| 3.5.3 | The BGAPI Protocol   | 20 |
| 3.5.4 | The BGLib Host Library                                     | 21 |
| 3.5.5 | BGScript™ Scripting Language                               | 22 |
| 3.5.6 | The Profile Toolkit  | 23 |
| 3.5.7 | C-Development Environment (Beta)                           | 24 |
| 3.6   | More Information about the Products                        | 24 |
| 4     | Getting Started with Bluetooth Smart Development           | 25 |
| 4.1   | Documentation and Tools                                    | 26 |
| 4.1.1 | Tools:   | 26 |
| 4.1.2 | Documentation:   | 26 |
| 4.1.3 | Presentations:   | 26 |

# 1 Introduction

This document is meant to provide a short introduction to *Bluetooth* Smart technology and to Bluegiga's *Bluetooth* Smart products. The purpose of this document is not to give a deep technology or product overview, but should act more as an introduction to both of them and give the necessary information to continue studying.

The document is organized into two sections. Firstly a quick introduction to *Bluetooth* Smart technology is given and then the Bluegiga's *Bluetooth* Smart product family is discussed.

## 2 What is Bluetooth Smart

*Bluetooth* low energy (*Bluetooth* 4.0) is a new, open standard developed by the *Bluetooth* SIG. It's targeted to address the needs of new modern wireless applications such as ultra-low power consumption, fast connection times, reliability and security. *Bluetooth* low energy consumes 10-20 times less power and is able to transmit data 50 times quicker than classical *Bluetooth* solutions.

Link: [How Bluetooth low energy technology works?](#)

*Bluetooth* low energy is designed for new emerging applications and markets, but it still embraces the very same benefits we already know from the classical, well established *Bluetooth* technology:

- **Robustness and reliability** - The adaptive frequency hopping technology used by *Bluetooth* low energy allows the device to quickly hop within a wide frequency band, not just to reduce interference but also to identify crowded frequencies and avoid them. On addition to broadcasting *Bluetooth* low energy also provides a reliable, connection oriented way of transmitting data.
- **Security** - Data privacy and integrity is always a concern in wireless, mission critical applications. Therefore *Bluetooth* low energy technology is designed to incorporate high level of security including authentication, authorization, encryption and man-in-the-middle protection.
- **Interoperability** - *Bluetooth* low energy technology is an open standard maintained and developed by the *Bluetooth* SIG. Strong qualification and interoperability testing processes are included in the development of technology so that wireless device manufacturers can enjoy the benefit of many solution providers and consumers can feel confident that equipment will communicate with other devices regardless of manufacturer.
- **Global availability** - Based on the open, license free 2.4GHz frequency band, *Bluetooth* low energy technology can be used in world wide applications.

There are two types of *Bluetooth* low energy devices:

- ***Bluetooth*Smart** devices that only support *Bluetooth* low energy and are optimized for low-power, low-cost and small size solutions.
- ***Bluetooth*Smart Ready devices** that support *Bluetooth* low energy and classical *Bluetooth* technologies and are interoperable with all the previously *Bluetooth* specification versions.

Key features of *Bluetooth* low energy wireless technology include:

- Ultra-low peak, average and idle mode power consumption
- Ability to run for years on standard, coin-cell batteries
- Low cost
- Multi-vendor interoperability
- Enhanced range

*Bluetooth* low energy is also meant for markets and applications, such as:

- Automotive
- Consumer electronics
- Smart energy
- Entertainment
- Home automation
- Security & proximity
- Sports & fitness

## 2.1 Classic Bluetooth vs. Bluetooth low energy

The table below shows a high level comparison between classic *Bluetooth* (also known as *Bluetooth* BR/EDR) and *Bluetooth* low energy technologies.

| Technical specification                         | Classic <i>Bluetooth</i> technology                         | <i>Bluetooth</i> low energy technology  |
|---|---|---|
| Radio frequency                                 | 2.4GHz  | 2.4GHz  |
| Distance/Range                                  | ~10-100 meters  | ~10-100 meters  |
| Symbol rate                                     | 1-3Mbps   | 1Mbps   |
| Application throughput                          | 0.9 – 2.1Mbps   | 0 - 250 kbps  |
| Nodes/Active slaves                             | 7   | Theoretically unlimited   |
| Security  | 56 to 128 bit   | 128-bit AES   |
| Robustness                                      | FHSS  | FHSS  |
| Latency (from not connected state to send data) | 100+ ms   | as low as 6ms   |
| Government regulation                           | Worldwide   | Worldwide   |
| Certification body                              | Bluetooth SIG   | Bluetooth SIG   |
| Voice capable                                   | Yes   | No  |
| Network topology                                | Point-to-point, scatternet                                  | Point-to-point, star  |
| Power consumption                               | 1 (reference value)   | 0.01 to 0.5 (use case dependent)  |
| Service discover                                | Yes   | Yes   |
| Profile concept                                 | Yes   | Yes   |
| Primary use cases                               | Mobile phones, headsets, stereo audio, automotive, PCs etc. | Mobile phones, gaming, PCs, sport & fitness, medical, automotive, industrial, automation, home electronics etc. |
| Profiles  | Serial Port, Hands-Free, OBEX, A2DP etc.                    | Proximity profile, Battery status, Weight scale, Heart rate monitor, Humidity etc.                              |

## 2.2 Backwards Compatibility

*Bluetooth* 4.0 single mode (*Bluetooth* Smart) devices are not inter-operable with classic *Bluetooth* devices such as *Bluetooth* 2.1 + EDR devices. Single mode devices are only compliant with other *Bluetooth* 4.0 devices.

The *Bluetooth 4.0 dual mode (Bluetooth Smart Ready)* devices on the other hand are backwards compatible and can be connected to all other *Bluetooth* devices, even those supporting the very old 1.0 standard. The dual mode devices typically are mobile phones and PCs which are not as power constrained as the single mode devices and need to support uses cases like hands-free or stereo headset connectivity.

If specification versions are used, then all *Bluetooth v.4.0* are inter-operable with each other, but NOT all *Bluetooth v.4.0* devices are inter-operable with older specification versions.

## 2.3 Bluetooth Smart branding

*Bluetooth* Smart Ready devices are the most effective way to connect to billions of *Bluetooth* devices in the market today, and the over 5 million *Bluetooth* enabled devices commercialized every single day. Examples include phones, tablets, PCs, TVs, even set-top boxes and game consoles that sit at the center of the consumers' connected world. These devices efficiently receive data sent from Classic *Bluetooth* devices and *Bluetooth* Smart devices and feed it into applications that turn data into useful information. These are the hub devices of the *Bluetooth* ecosystem. [Source : [Bluetooth SIG](#) ]



To bear *Bluetooth* Smart Ready mark, a device must meet three criteria:

- Be built to *Bluetooth* v4.0 specifications with GATT-based architecture
- Feature a dual-mode low energy radio
- Allow consumers to update the device software

*Bluetooth* Smart devices are designed to gather a specific type of information – are all the windows on my house locked, what is my blood glucose level, how much do I weigh today? – and send it to a *Bluetooth* Smart Ready device. Examples include heart-rate monitors, blood-glucose meters, smart watches, window and door security sensors, car key fobs, and blood-pressure cuffs – the opportunities are endless. [Source : [Bluetooth SIG](#) ]



To bear the *Bluetooth* Smart mark, the device must meet these three criteria:

- Be built to *Bluetooth* v4.0 specifications with GATT-based architecture
- Feature a single-mode low energy radio
- Use the GATT-based architecture to enable particular functionality of the device

### 2.3.1 Compatibility



If your product bears this logo...

It's compatible with products bearing any of these logos...



**More information:**

- [https://www.bluetooth.org/apps/content/default.aspx?doc\\_id=242825](https://www.bluetooth.org/apps/content/default.aspx?doc_id=242825)

## 2.4 More Information about the Technology

Want to learn more about *Bluetooth* low energy technology? Please have a look at the following material and links:

### ***Bluetooth* specifications:**

- <https://www.bluetooth.org/Technical/Specifications/adopted.htm>

### ***Bluetooth* developer web site**

- <http://developer.bluetooth.org/>

### ***Bluetooth SIG's Bluetooth* low energy web sites:**

- <https://www.bluetooth.org/Events/Training/LowEnergyTraining.htm>
- <http://bluetooth.com/Pages/Low-Energy.aspx>

### ***Bluetooth* low energy at Wikipedia:**

- [http://en.wikipedia.org/wiki/Bluetooth\\_low\\_energy](http://en.wikipedia.org/wiki/Bluetooth_low_energy)

## 3 Bluegiga's Bluetooth Smart Products

### 3.1 BLE112 - Bluetooth Smart Module

#### 3.1.1 Description

BLE112 is a *Bluetooth* Smart module targeted for low power sensors and accessories. It integrates all features required for a *Bluetooth* Smart application: *Bluetooth* radio, software stack and GATT based profiles. BLE112 *Bluetooth* Smart module can also host end user applications, which means no external micro controller is required in size or price constrained devices. BLE112 *Bluetooth* Smart module also has flexible hardware interfaces to connect to different peripherals and sensors. BLE112 *Bluetooth* smart module can be powered directly from a standard 3V coin cell battery or pair of AAA batteries. In lowest power sleep mode it consumes only 500 nA and will wake up in few hundred microseconds.

#### 3.1.2 Key features

- *Bluetooth* v.4.0, single mode compliant
  - Supports master and slave modes
  - Supports up to eight connections
- Integrated *Bluetooth* Smart stack
  - GAP, GATT, L2CAP and SMP
  - *Bluetooth* Smart profiles
- Radio performance
  - Transmit power : +3 dBm to -23 dBm
  - Receiver sensitivity: -93 dBm
- Ultra low current consumption
  - Transmit: 27 mA (0 dBm)
  - Sleep mode 3: 0.5 uA
- Flexible peripheral interfaces
  - UART or SPI
  - Software I2C
  - PWM, GPIO
  - 12-bit ADC
- Host interfaces
  - UART
  - USB
- Programmable 8051 processor for stand-alone operation
  - Simple Bluegiga BGScript™ scripting language for quick application development
  - Supports native C applications with the IAR Embedded Workbench SDK
  - Bluegiga Profile Toolkit™ allowing the quick development of GATT based profiles
  - Free Software Development Kit
- *Bluetooth*, CE, FCC, IC and South-Korea and Japan qualified

### 3.1.3 Benefits

- Fully integrated *Bluetooth* Smart solution
  - Integrated *Bluetooth* Radio, micro controller and software stack
  - Fast time to market
  - Low development risks
- Application hosting capabilities
  - All application code can be executed on the BLE112
  - No need for external micro controller
  - Lower cost and smaller physical size
- Flash based
  - Firmware is field upgradable
  - Application data can be stored on the flash
  - Settings can be stored on the flash
- Good radio performance
  - Long range and robust connections
  - Software programmable TX power
- *Bluetooth*, CE, FCC, IC, Japan and South Korea qualified
  - Proven interoperability
  - Minimal qualification costs

#### PHYSICAL OUTLOOK



## 3.2 BLED112 - Bluetooth Smart USB Dongle

### 3.2.1 Description

BLED112 *Bluetooth* Smart Dongle integrates all *Bluetooth* Smart features. The USB dongle can a virtual COM port that enables simple host application development using a simple application programming interface. The BLED112 can be used for *Bluetooth* Smart development. With two BLED112 dongles you can quickly prototype new *Bluetooth* Smart application profiles by utilizing Bluegiga Profile Toolkit™ and also automate inmodule software functions with Bluegiga BGScript™ .

### 3.2.2 Key features

- *Bluetooth* v.4.0, single mode compliant
  - Supports master and slave modes
  - Supports up to eight connections
- Integrated *Bluetooth* Smart stack
  - GAP, GATT, L2CAP and SMP
  - *Bluetooth* Smart profiles
- Radio performance
  - Transmit power : +0 dBm to -27 dBm
  - Receiver sensitivity: -93 dBm
- Host interfaces
  - USB (virtual COM port emulation)
- Programmable 8051 processor for stand-alone operation
  - Simple Bluegiga BGScript™ scripting language for quick application development
  - Bluegiga Profile Toolkit™ allowing the quick development of GATT based profiles
  - Free Software Development Kit
- *Bluetooth*, CE, FCC, IC and South-Korea and Japan qualified

### 3.2.3 Benefits

- Fully integrated *Bluetooth* Smart solution
  - Integrated *Bluetooth* Radio, micro controller and software stack
  - Fast time to market
  - Low development risks
- Application hosting capabilities
  - All application code can be executed on the BLED112
  - No need for external micro controller
  - Lower cost and smaller physical size
- Flash based
  - Firmware is field upgradable
  - Application data can be stored on the flash
  - Settings can be stored on the flash
- Good radio performance
  - Long range and robust connections
  - Software programmable TX power
- *Bluetooth*, CE, FCC, IC, South Korea and Japan qualified
  - Proven interoperability
  - Minimal qualification costs

#### PHYSICAL OUTLOOK



## 3.3 BLE113 - Bluetooth Smart Module

### 3.3.1 Description

BLE113 is a *Bluetooth* Smart module targeted for small and low power sensors and accessories. It integrates all features required for a *Bluetooth* Smart application: *Bluetooth* radio, software stack and GATT based profiles. BLE113 *Bluetooth* Smart module can also host end user applications, which means no external micro controller is required in size or price constrained devices. BLE113 *Bluetooth* Smart module also has flexible hardware interfaces to connect to different peripherals and sensors. BLE113 *Bluetooth* Smart module can be powered directly from a standard 3V coin cell battery or pair of AAA batteries. In lowest power sleep mode it consumes only 500 nA and will wake up in few hundred microseconds.

BLE113 is about 30% lower power and smaller than the BLE112 Bluetooth Smart Module

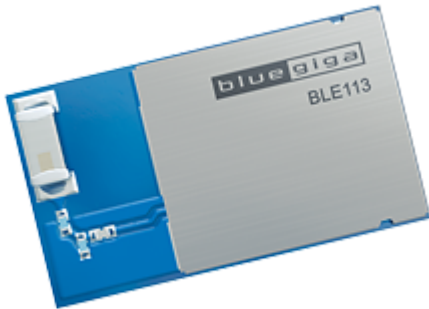
### 3.3.2 Key features

- *Bluetooth* v. 4.0, single mode compliant
  - Supports master and slave modes
  - Up to eight connections
- Integrated *Bluetooth* Smart stack
  - GAP, GATT, L2CAP and SMP
  - *Bluetooth* Smart profiles
- Radio performance
  - Transmit power : 0 dBm to -23 dBm
  - Receiver sensitivity: -93 dBm
- Ultra low current consumption
  - Transmit: 18.2 mA (0 dBm)
  - Transmit: 14.3 mA (0 dBm and DC/DC)
  - Receive: 14.3 mA
  - Sleep mode 3: 0.4 uA
- Flexible peripheral interfaces
  - UART and SPI
  - I2C, PWM and GPIO
  - 12-bit ADC
- Host interfaces:
  - UART
- Programmable 8051 processor for stand-alone operation
  - Simple Bluegiga BGScript™ scripting language for quick application development
  - Supports native C applications with the IAR Embedded Workbench SDK
  - Bluegiga Profile Toolkit™ allowing the quick development of GATT based profiles
  - Free Software Development Kit
- Dimensions: 9.15 x 15.75 x 1.9 mm
- *Bluetooth*, CE, FCC, IC, South Korea and Japan qualified

### 3.3.3 Benefits

- BLE113 has thirty percent lower power and smaller size than the BLE112 *Bluetooth* Smart Module
- Fully integrated *Bluetooth* Smart solution
- Integrated *Bluetooth* radio, micro controller and software stack
- Fast time-to-market
- Low development risks

### PHYSICAL OUTLOOK





### 3.4 DKBLE112 and DKBLE113 - BLE112 and BLE113 Development Kits

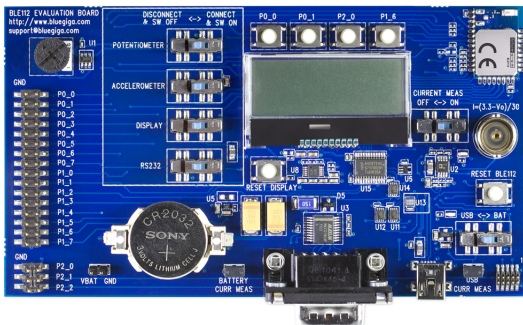
BLE112 and BLE113 development kits provide a quick environment for prototyping Bluetooth 4.0 Smart applications. It provides both a hardware and a software development environment for evaluating BLE112 or BLE113 Bluetooth 4.0 single mode product, respectively.

#### Package contains:

- 1 BLE112/113 evaluation board
  - BLE112/113 module
  - Display
  - Accelerometer
  - Potentiometer
  - UART, USB and I/O interfaces
  - Current measurement points
  - CR2032 battery holder
  - Programming interface
  - integrated programming function (BLE113 evaluation boards)
- 2 BLE112/113 Bluetooth 4.0 single mode modules
- 1 BLE112 Bluetooth 4.0 single mode USB dongle
- 1 CC debugger firmware programming cable (DKBLE112)
- 1 USB cable
- 1 CR2032 coin cell battery
- Bluetooth low energy software development kit

#### Example applications:

- Health Thermometer
- Heart Rate Transmitter
- FindMe target
- Proximity Profile



### 3.5 Bluetooth Smart Software

The Bluegiga *Bluetooth* Smart Software enables developers to quickly and easily develop *Bluetooth* Smart applications without in-depth knowledge of the *Bluetooth* Smart technology. The *Bluetooth* Smart Software consists of two parts:

- The *Bluetooth* Smart Stack
- The *Bluetooth* Smart Software Development Kit (SDK)

#### 3.5.1 The Bluetooth Smart Stack

The *Bluetooth* Smart stack is a fully *Bluetooth* 4.0 single mode compatible software stack implementing slave and master modes, all the protocol layers such as L2CAP, Attribute Protocol (ATT), Generic Attribute Profile (GATT), Generic Access Profile (GAP) and security and connection management.

The *Bluetooth* Smart is meant for the Bluegiga *Bluetooth* Smart products such as BLE112, BLE113 and BLED112 and it runs on the embedded MCU used in these products so no host is needed.

#### 3.5.2 The Bluetooth Smart SDK

The *Bluetooth* Smart SDK is a software development kit, which enables the device and software vendors to develop products on top of the Bluegiga's *Bluetooth* Smart hardware and software.

The *Bluetooth* Smart SDK supports multiple development models and the software developers can decide whether the application software runs on a separate host (a low power MCU) or whether they want to make fully standalone devices and execute their code on the MCU embedded in the Bluegiga *Bluetooth* Smart modules. The SDK also contains documentation, tools for compiling the firmware, installing it into the hardware and lot of example application speeding up the development process.

Fully standalone applications can be developed using a simple scripting language called BGScript™. Several profiles and examples are also offered as a part of the *Bluetooth* Smart Software in order to easily develop the *Bluetooth* Smart compatible end products.

Bluegiga's *Bluetooth Smart Software* provides a complete development framework for *Bluetooth* low energy application implementers.

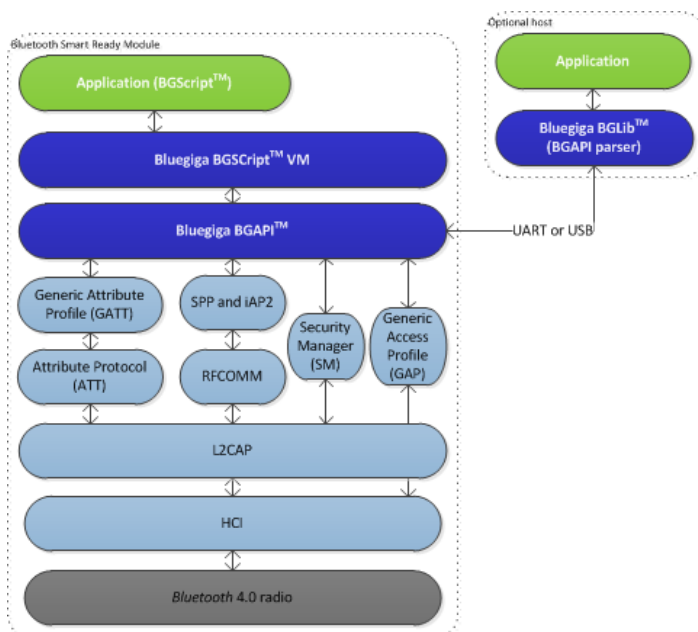


Figure: Bluetooth Smart Software

The *Bluetooth Smart* Software architecture is illustrated and it consists of the following components

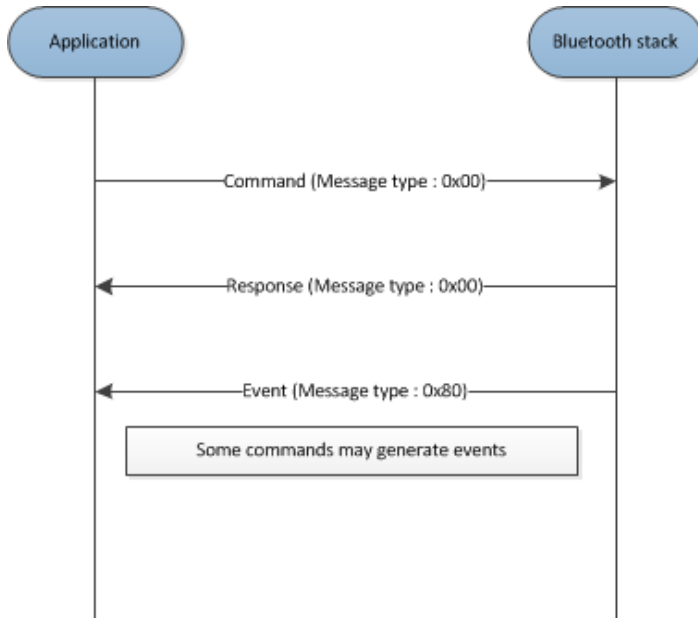
- The *Bluetooth* Smart stack implementing the *Bluetooth* low energy protocol
- **BGAPI™** APIs that enable the software developers to interface to the *Bluetooth* Smart Stack
- **BGScript™** Virtual Machine (VM) and scripting language which enable application code to be developed and executed directly on the *Bluetooth* Smart hardware
- **BGLib™** lightweight host library which implements the BGAPI binary protocol and parser and is target for applications where separate host processor is used to interface to the *Bluetooth* Smart modules over UART or USB.
- **Profile Toolkit™** is a GATT based profile development tool that enables software developers quickly and easily to describe the *Bluetooth* Smart profiles, services and characteristics using simple XML templates

Each of these components are described in more detail in the following chapters.

### 3.5.3 The BGAPI Protocol

For applications where a separate host is used to implement the end user application, a transport protocol is needed between the host and the *Bluetooth* stack. The transport protocol is used to communicate with the *Bluetooth* stack as well to transmit and receive data packets. This protocol is called BGAPI and it's a lightweight binary based communication protocol designed specifically for ease of implementation within host devices with limited resources.

The BGAPI protocol is a simple command, response and event based protocol and it can be used over UART SPI (at the moment not supported by the *Bluetooth* Smart hardware) or USB interfaces.



**Figure: BGAPI Protocol**

The BGAPI provides access for example to the following layers in the *Bluetooth* Smart Stack:

- **Generic Access Profile** - GAP allows the management of discoverability and connectability modes and open connections
- **Security manager** - Provides access to the *Bluetooth* low energy security functions
- **Attribute database** - An interface to access the local attribute database
- **Attribute client** - Provides an interface to discover, read and write remote attributes
- **Connection** - Provides an interface to manage *Bluetooth* low energy connections
- **Hardware** - An interface to access the various hardware layers such as timers, ADC and other hardware interfaces
- **Persistent Store** - User interface to access the parameters of the radio hardware and read/write data to non-volatile memory
- **System** - Various system functions, such as querying the hardware status or reset it

### 3.5.4 The BGLib Host Library

For easy implementation of BGAPI protocol an ANSI C host library is available. The library is easily portable ANSI C code delivered within the *Bluetooth* Smart SDK. The purpose is to simplify the application development to various host environments.

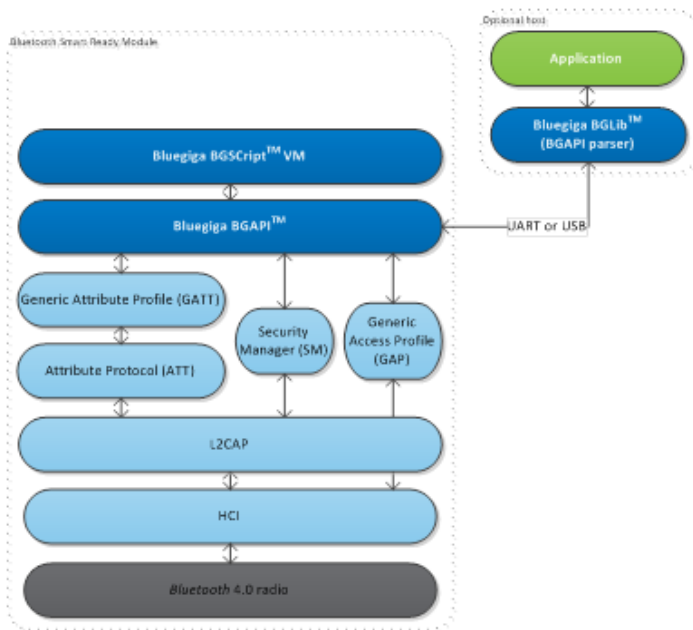


Figure: BGLib host library

### 3.5.5 BGScript™ Scripting Language

The *Bluetooth* Smart SDK Also allows the application developers to create fully standalone devices without a separate host MCU and run all the application code on the Bluegiga *Bluetooth* Smart Hardware. The *Bluetooth* Smart modules can run simple applications along the *Bluetooth* Smartstack and this provides a benefit when one needs to minimize the end product's size, cost and current consumption. For developing standalone *Bluetooth* Smart applications the SDK includes the Script VM, compiler and other BGScript development tools. BGScript provides access to the same software and hardware interfaces as the BGAPI protocol and the BGScript code can be developed and compiled with free-of-charge tools provided by Bluegiga.

Typical BGScript applications are only few tens to hundreds lines of code, so they are really quick and easy to develop and lots of ready made examples are provides with the SDK.

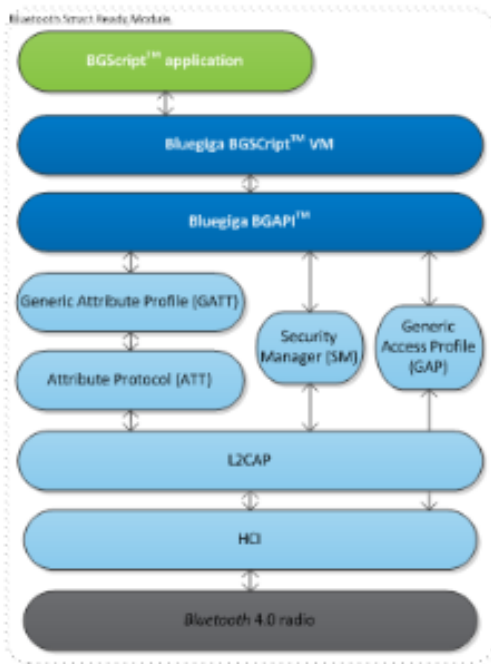


Figure: BGScript architecture

#### BGScript code example:

##### BGScript code

```
# System Started
event system_boot(major, minor, patch, build, ll_version, protocol_version,hw)

    #Enable advertising mode
    call gap_set_mode(gap_general_discoverable,gap_undirected_connectable)
    #Enable bondable mode
    call sm_set_bondable_mode(1)
    #Start timer at 1 second interval (32768 = crystal frequency)
    call hardware_set_soft_timer(32768)
end
```

### 3.5.6 The Profile Toolkit

The *Bluetooth* Smart profile toolkit a simple set of tools, which can used to describe GATT based *Bluetooth* Smart services and characteristics. The profile toolkit consists of a simple XML based description language and templates, which can be used to describe the devices GATT database. The profile toolkit also contains a compiler, which converts the XML to binary format and generates API to access the characteristic values.

```
<?xml version="1.0" encoding="UTF-8" ?>
<configuration>
  <service uuid="1800">
    <description>Generic Access Profile</description>
    <characteristic uuid="2a00">
      <properties read="true" const="true" />
      <value>BGDemo sensor</value>
    </characteristic>
    <characteristic uuid="2a01">
      <properties read="true" const="true" />
      <value type="hex">4142</value>
    </characteristic>
  </service>
</configuration>
```

**Figure: A profile toolkit example of GAP service**

### 3.5.7 C-Development Environment (Beta)

The *Bluetooth* Smart C-Development Environment (shortly, C SDK) allows software engineers to build and install the example applications provided in the SDK and also to develop independently *Bluetooth* Smart applications for the Bluegiga's *Bluetooth* Smart modules. The SDK supports the development and debugging of applications written in ANSI C for the on-board 8051 micro controller inside the *Bluetooth* Smart modules.

Code is written using the IAR's Embedded Workbench for 8051 editor and built and compiled along with the *Bluetooth* Smart firmware supplied with the SDK. The resultant firmware can be downloaded to, run and debugged on a real *Bluetooth* Smart hardware such as the BLE112 or BLE113 *Bluetooth* Smart module development kits. Example codes are provided with the SDK that implement simple *Bluetooth* Smart applications, GATT based profiles and peripheral functionality and when used with Bluegiga library functions enable developers to quickly and easily create *Bluetooth* Smart devices.

The beta-level C SDK for Bluetooth Smart is available by requesting that through Bluegiga Online Support (<http://www.bluegiga.com/support>).

## 3.6 More Information about the Products

More information about the products can be found from:

- [Bluegiga Web Pages](#)
- [Bluegiga Online Support](#)



## 4 Getting Started with Bluetooth Smart Development

If you have not implemented a Bluetooth Smart application with Bluegiga's products before. This section briefly describes the recommended path to start the implementation and describes the available documents, tools and examples, which help you to get started.

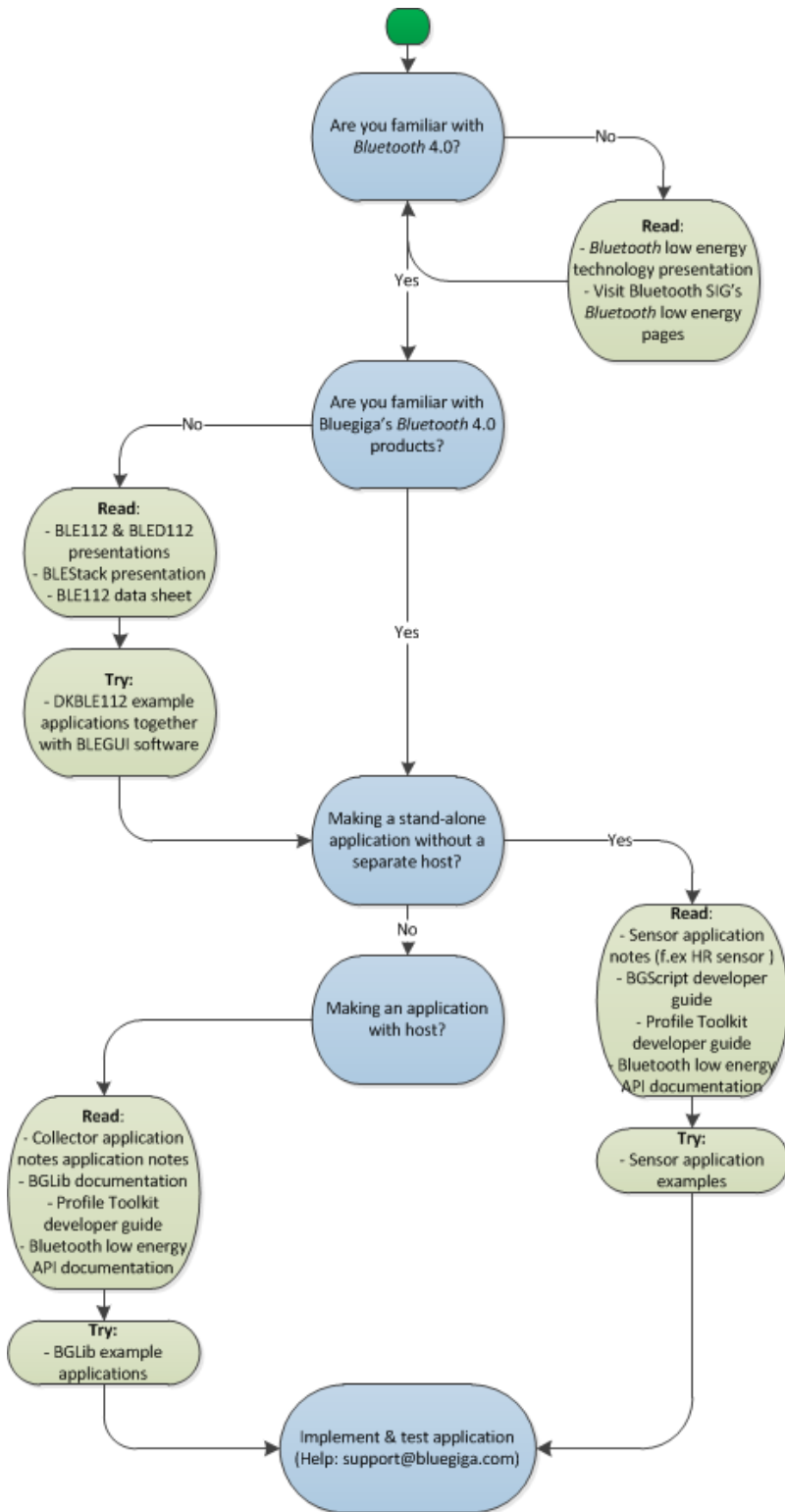


Figure: Recommended development path

## 4.1 Documentation and Tools

This section briefly summarizes the available *Bluetooth* Smart tools and documentation supporting the application development.

### 4.1.1 Tools:

- **BLEGUI** : This application can be used to control BLE112 or BLED112 over UART or USB. BLEGUI sends the BGAPI command to the hardware and parses the responses. It's a useful tool to get familiar with the products and try out Bluetooth low energy applications.
- **BGBuild** : BGBuild application compiles the hardware configuration file, GATT database, BGScript and the Bluegiga *Bluetooth* 4.0 single mode stack into a single binary image (.hex), which can be installed into BLE112 or BLED112 hardware.
- **BLE Update** : Bluegiga's flash programmer application can be used to update the firmware of BLE112 and BLE113 over the debug/programming interface. BGBuild tool can be used through BLE Update Tool for compiling the firmware and programming that to the module.
- **DFUTool** : DFUTool can be used to update the firmware of BLE112 or BLED112 using USB DFU protocol.
- **BGLib** : A C library (available as a source code) for the host that implements the BGAPI protocol
- **C SDK (Beta)** : Bluegiga BLE C SDK (libraries, examples, and project templates) allowing to develop and build applications using the IAR's Embedded Workbench for 8051 editor.
- **Thermometer-demo**: Thermometer demo is a Windows command line application, which implements Thermometer collector using BGLib. It can scan Bluetooth 4.0 single-mode devices, and read temperature values from them.
- **Collector demo**: Collector demo implements a simple Windows HR collector application, which scans, connects and reads HR and Battery status values from a HR sensor

### 4.1.2 Documentation:

- **BluetoothSmart - Getting Started** : This document, describes the very basics of *Bluetooth* low energy and related Bluegiga products
- **Bluetooth Smart Configuration Guide** : This instructs you how to configure the static project, hardware, application (SW) settings.
- **BGScript Developer guide** : Describes the BGScript scripting language, it's features and limitations. Contains also practical BGScript examples.
- **Profile Developer Toolkit Developer Guide** : Describes the basics of *Bluetooth* LE profile development, as well the features and syntax of hardware and GATT XML files. Contains also practical examples.
- **BluetoothSmart Software API Documentation** : This document contains the BGAPI, BGLib and BGScript API. Describes the available commands, responses, events and their parameters. API reference document also explains the basics of *Bluetooth* low energy technology.
- **BluetoothSmart Software C API Documentation**: This document describes the C API for Bluegiga *Bluetooth* Smart C-Development Environment.
- **BLEGUI User Guide** : The document describes how the BLEGUI application works and how to use it
- **Application notes**: Various application notes describe specific use cases like for example Heart Rate Sensor or Health Thermometer collector and walk through the necessary development steps required to implement those.

### 4.1.3 Presentations:

- **Bluetooth low energy technology presentation** : A more in-depth presentation about *Bluetooth* low energy technology, how it works and what applications it's target for.
- **BLE112 Product presentation** : A short introduction to BLE112 *Bluetooth* 4.0 single mode module
- **BLE113 Product presentation** : A short introduction to BLE112 *Bluetooth* 4.0 single mode module
- **BLED112 Product presentation** : A short introduction to BLED112 *Bluetooth* 4.0 single mode USB dongle

## Contact information

**Sales:** [sales@bluegiga.com](mailto:sales@bluegiga.com)

**Technical support:** <http://www.bluegiga.com/support/>

**Orders:** [orders@bluegiga.com](mailto:orders@bluegiga.com)

**WWW:** <http://www.bluegiga.com>

**Head Office / Finland:** Phone: +358-9-4355 060  
Fax: +358-9-4355 0660  
Sinikalliontie 5 A  
02630 ESPOO  
FINLAND

**Head address / Finland:** P.O. Box 120  
02631 ESPOO  
FINLAND

**Sales Office / USA:** Phone: +1 770 291 2181  
Fax: +1 770 291 2183  
Bluegiga Technologies, Inc.  
3235 Satellite Boulevard, Building 400, Suite 300  
Duluth, GA, 30096, USA

**Sales Office / Hong-Kong:** Phone: +852 3182 7321  
Fax: +852 3972 5777  
Bluegiga Technologies, Inc.  
Unit 10-18, 32/F, Tower 1, Millennium City 1,  
388 Kwun Tong Road, Kwun Tong, Kowloon,  
Hong Kong