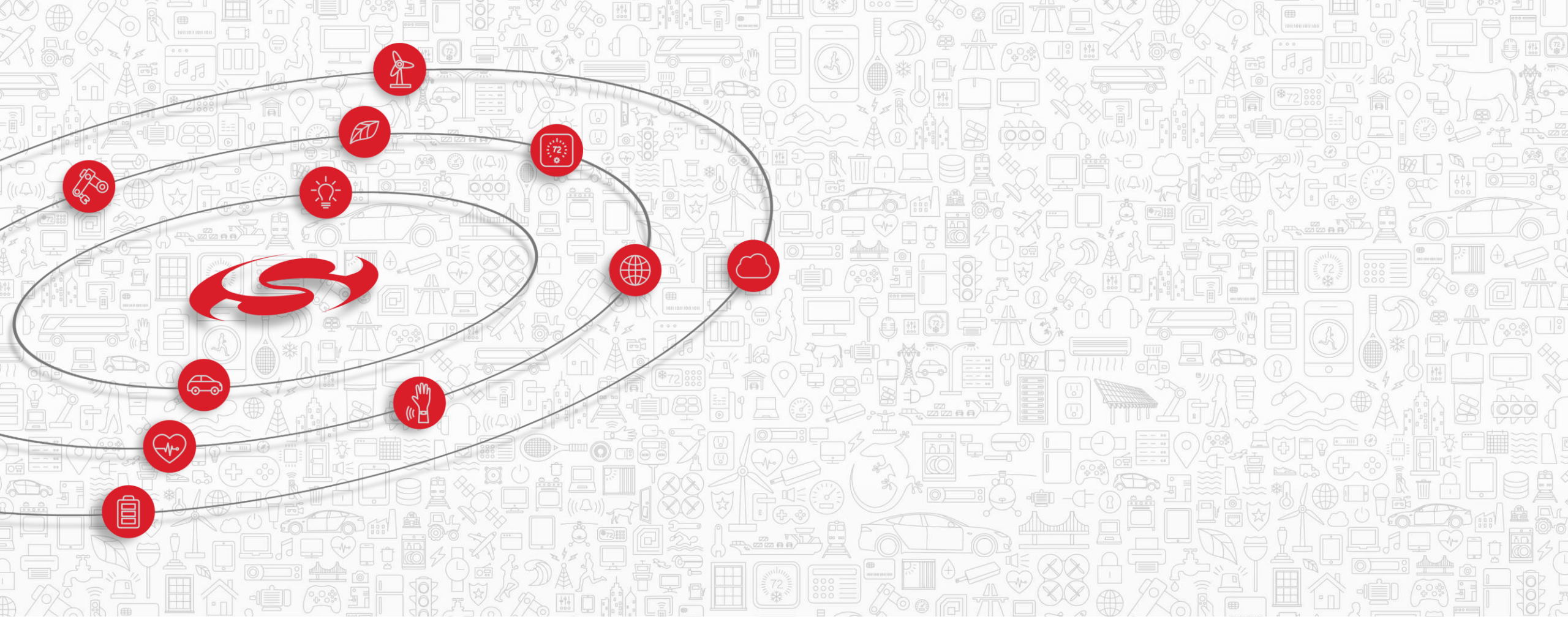


BT121 *Bluetooth*® Smart Ready Module

July 2016

SILICON LABS

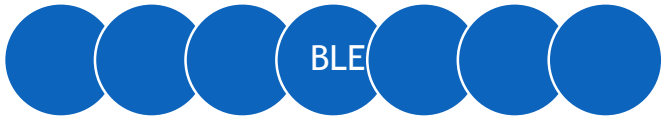
TOPICS

- Bluetooth Smart vs. Smart Ready
- Bluetooth Smart Ready Use Cases
- BT121 Key Features
- BT121 Benefits
- BT121 Overview
- *Bluetooth* Smart Ready Software
- Development Tools
- Certifications

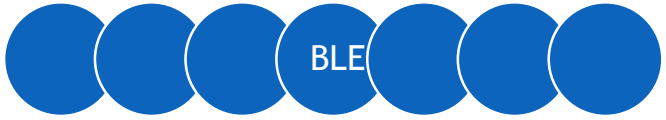
Bluetooth Smart Ready Use Cases

- **Reason 1 : Compatibility**
- **Legacy iOS**
  - iPhone 4 and older
  - iAP must be used
- **iPhone 4S and newer**
  - Bluetooth smart can be used
  - No MFI
  - Lower power consumption
- **Android 4.3 and newer**
  - Bluetooth smart can be used
  - Lower power consumption
- **Andoid 2.x - 4.2**
  - Bluetooth SPP must be used

Legacy iOS



iPhone 4s+



Android 4.3+

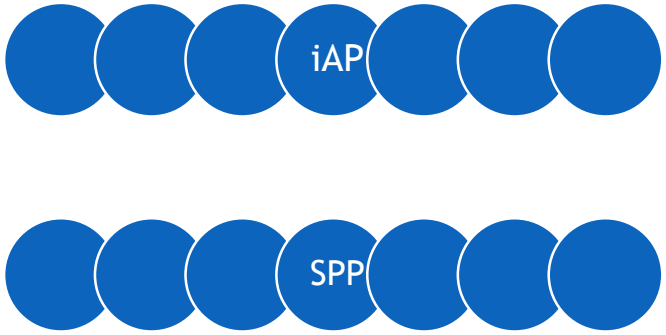
Android 2.x – 4.2

Bluetooth Smart Ready Use Cases

- **Reason 2 : Throughput**

- **iOS**
  - ~300 kbps over iAP
  - Bluetooth Smart ~50 kbps

- **Android**
  - ~1000 kbps over SPP
  - Bluetooth Smart ~50 kbps

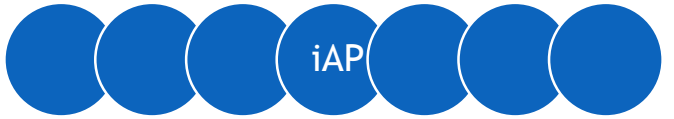


iOS

Android

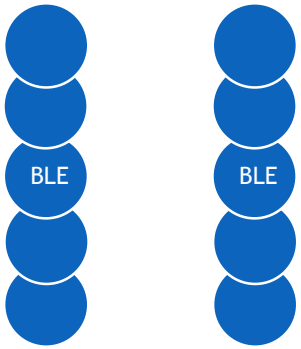
Bluetooth Smart Ready Use Cases

- **Reason 3 : Bluetooth Smart bridging**
- Aggregating data from one or multiple BLE devices and forwarding it to smart phone and/or tablets



iOS

Android



Key Features

- ***Bluetooth* v.4.2 dual mode**
  - Supports master and slave modes
  - Up to 6 x BR/EDR and 7 x BLE connections
  - 1x BR/EDR + 7 x BLE connections

- **Radio Performance**
  - Transmit power: +8 (BLE) / 12 dBm (BR/EDR)
  - Receiver sensitivity: -95 dBm
  - Link budget 103/107 dB
  - Range up tp 200-400 meters

- **Low Current Consumption**
  - Full EDR transmit 55 mA
  - BLE connected 250 uA
  - Sleep mode 81 uA

- **Integrated *Bluetooth* Smart Ready stack**
  - SPP, iAP2 over Bluetooth BR/EDR
  - HID over BR/EDR
  - GATT over BR
  - Common GAP, SMP and L2CAP
  - ATT and GATT for Bluetooth Smart
  - Any *Bluetooth* Smart profile(s)

- **Flexible Peripheral Interfaces**
  - UART, SPI and I2C serial interfaces
  - GPIO with interrupts
  - 12-bit ADC

- **Host Interfaces**
  - UART

- **Compact Size**
  - 11.0 mm x 13.9 mm x 2.2 mm
  - 153 mm^2

- **Programmable ARM Cortex M0 processor**

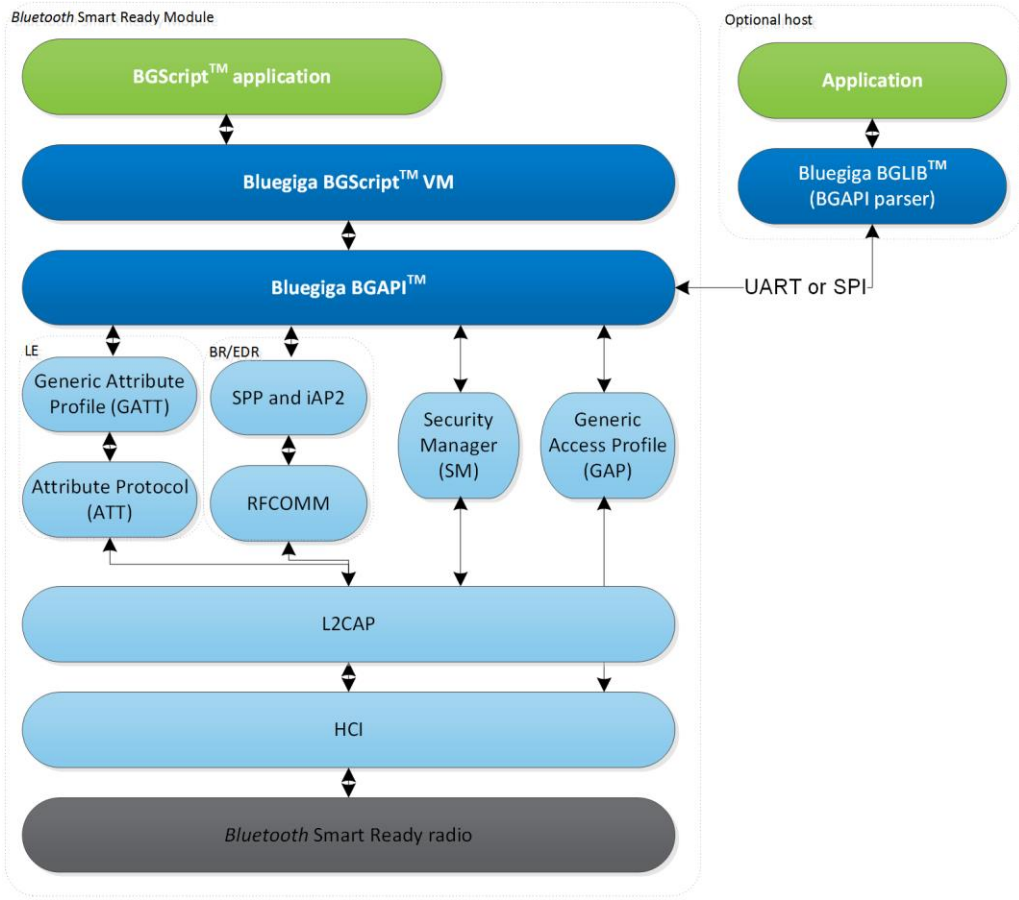
- ***Bluetooth*, CE, FCC, IC, South-Korea and Japan qualified**

Benefits

- **Excellent Radio Performance in a Compact Form Factor**
  - Robust, long range connectivity
  - Small PCB area requirements
- **Application Hosting Capabilities**
  - eBoM and size savings to end user
- **Bluetooth Smart Ready**
  - Connectivity to both legacy and new Bluetooth devices
  - Bluetooth Smart to BR/EDR bridging
- **Flash Based**
  - On-the-Field firmware updates over UART or SPI
  - Application and data can be stored on the flash
- ***Bluetooth*, CE, FCC, IC, Japan and Korea Qualifications**
  - Minimal qualification costs
  - Proven interoperability

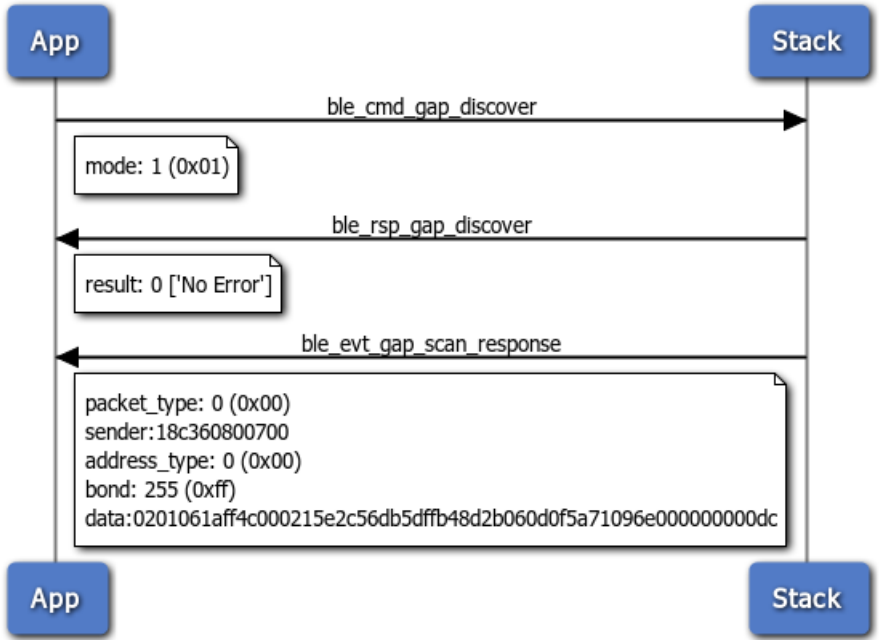
Bluetooth Smart Software

- ***Bluetooth* 4.2 Smart Ready Stack**
- **Features**
  - Bluetooth 4.2 Dual Mode Compliant
  - Master and slave mode support
  - Up to 6 BR/EDR Connections
  - Up to 7 BLE connections
  - 1x BR/EDR + 7 x BLE connections
  - 1Mbps over SPP
  - ~250 kbps over iAP2
- **Free of Charge SDK with Flexible APIs**
  - **BGAPI™** : A simple protocol over UART or USB interfaces
  - **BGLIB™** : A C library for host processors implementing BGAPI
  - **BGScript™** : script programming language for standalone devices
  - **Profile Toolkit™** : XML based GATT profile development tool
- **Field Upgradable**
  - DFU over UART interface



Bluetooth Smart Software

- **BGAPI™ serial protocol:** A simple binary command, response and event protocol between the host and the stack
  - Used when a separate host (MCU) is used to control BT121 over UART
  - Small RAM and flash memory



Bluetooth Smart Software

- **BGLIB™ library:** A portable ANSI C library, which implements the BGAPI serial protocol parser
  - Easy to port to various architectures such as: ARM Cortex
  - Ported to multiple programming languages: ANSI C, Java, Python and C#
  - Uses function-call back architecture

C Functions

```
/* Function */
void ble_cmd_gap_connect_direct(
    bd_addr address ,
    uint8 addr_type ,
    uint16 conn_interval_min ,
    uint16 conn_interval_max ,
    uint16 timeout
);

/* Callback */
void ble_rsp_gap_connect_direct(
    uint16 result ,
    uint8 conn
);
```

Bluetooth Smart Software

- **BGScript™ scripting language:** A simple BASIC-like application scripting language
  - Used to program the BT121's MCU
  - Enables very fast application development
  - Cuts out the need for an external MCU

```
# System boot event listener : Executed when BLE112 is started
event system_boot(major ,minor ,patch ,build ,ll_version ,protocol_version ,hw )


    # Configure ADV interval to 1000ms and start advertisements an all channels
    call gap_set_adv_parameters(1600, 1600, 7)

    # Start generic advertisement and enable connections
    call gap_set_mode(2,2)

   #Start a continuous software timer, which generates interrupts every 1000ms
   call hardware_set_soft_timer(32768, 1, 0)
end
```

Why BGScript™

- **Very Simple to Use**
  - Fast development of simple *Bluetooth* Smart applications
  - Most applications are 100-200 lines of code
  - Simple iBeacon in 40 lines of code
- **Free Software Development Tools**
  - Bluegiga provides a free BGScript SDK
  - Comes with compiler, example applications and documentation
- **Several Example Scripts Available**
  - Heart rate transmitter
  - Blood glucose Sensor
  - Proximity reporter
  - iBeacon and Physical Web beacon
  - Over-the-Air firmware update
  - iOS and Android applications
- **Cuts out the need for external MCU**
  - Reduced eBoM
  - Smaller footprint

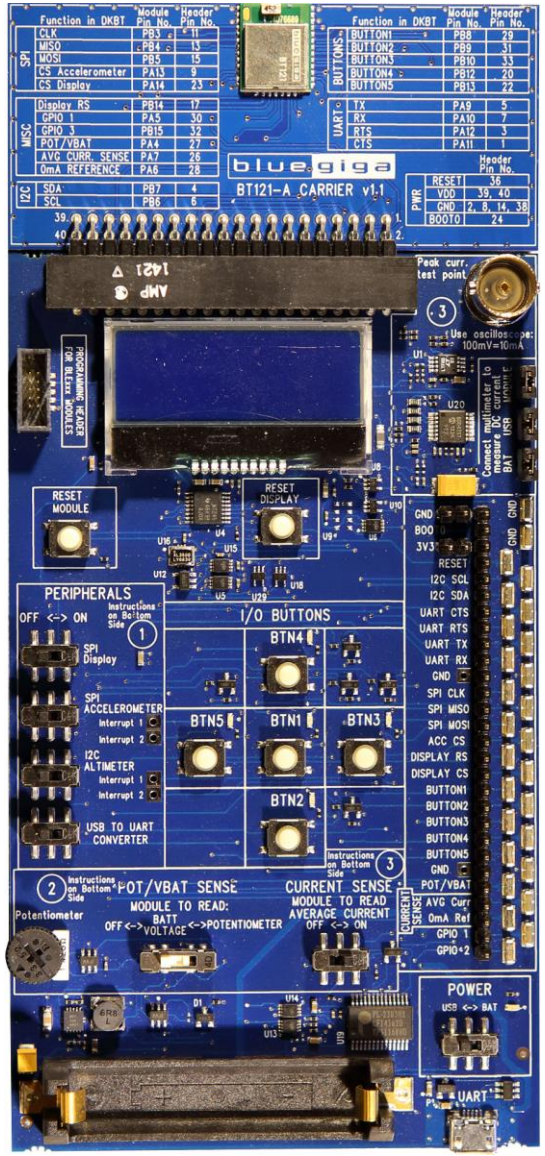
Bluetooth Smart Software

- **Bluetooth Smart Profile Toolkit™:**
  XML based tool for creating Smart profiles
- **Bluetooth Smart profiles are very simple**
- **Can be describes with a single file of XML**
- **Several example profiles and services available**
  - Heart Rate transmitter
  - Proximity reporter
  - Blood glucose sensor
  - iBeacon

```
<service uuid="1800">
  <description>Generic Access Profile</description>

  <characteristic uuid="2a00">
    <properties read="true" const="true" />
    <value>BG Demo</value>
  </characteristic>

  <characteristic uuid="2a01">
    <properties read="true" const="true" />
    <value type="hex">4142</value>
  </characteristic>

</service>
```

Development Tools

- **DKBT Development Kit Contains**
  - Display
  - On-board accelerometer, altimeter and potentiometer
  - AAA battery holder
  - USB-to-Serial converter
  - On-board firmware programming
  - Current measurement points
  - 5 buttons and leds
  - I/O headers
- **BT121 Carrier Board**
- **Bluetooth Smart Ready SDK**
  - BGAPI™ documentation
  - BGScript™ development tools
  - BGLIB™ source code
  - Profile Toolkit™
  - BGScript and BGLIB examples
  - Profile examples
- **Documentation**
- **iOS and Android example applications**



Certifications

- ***Bluetooth***
  - BT121: Controller subsytem
  - Software : Host subsystem
- **CE**
  - EN300328
  - EN301489-1/17
  - EN60950-1
- **FCC**
  - Part 15C modular approval
- **Industry Canada**
  - IC modular certification
- **South Korea**
  - KCC certification
- **Japan**
  - ARIB-STD-66

Thank You