BLE121LR *Bluetooth*® Smart Long Range Module

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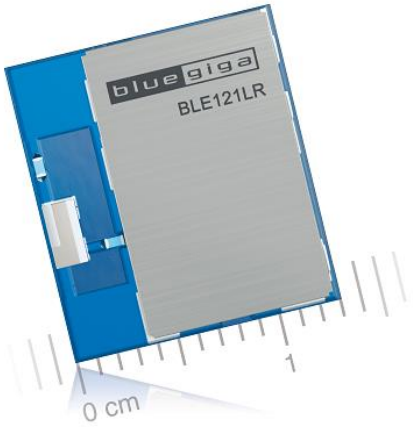
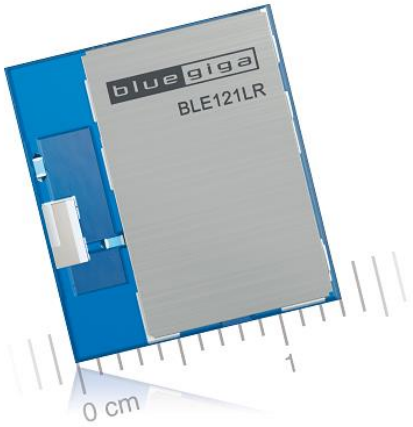
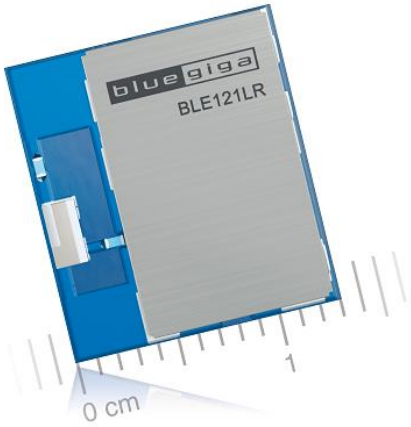


Key Features



- ***Bluetooth* v.4.0, single mode compliant**
  - Supports master and slave modes
  - Up to 8 connections
- **Integrated *Bluetooth* Smart stack**
  - GAP, GATT, L2CAP and SMP
  - *Bluetooth* Smart profiles
- **Radio Performance**
  - Transmit power : +8 dBm
  - Receiver sensitivity: -98 dBm
- **Low Current Consumption**
  - Transmit: 36 mA
  - Transmit: 25 mA (with DC/DC)
  - Sleep mode 3: 0.5 uA
- **Flexible Peripheral Interfaces**
  - UART, SPI and I2C serial interfaces
  - PWM, GPIO
  - 12-bit ADC
- **Host Interfaces**
  - UART
- **Host Interfaces**
  - 14.7 x 13.0 x 1.8 mm
- **Programmable 8051 processor for stand-alone operation**
- ***Bluetooth*, CE, FCC, IC, South-Korea and Japan qualified**

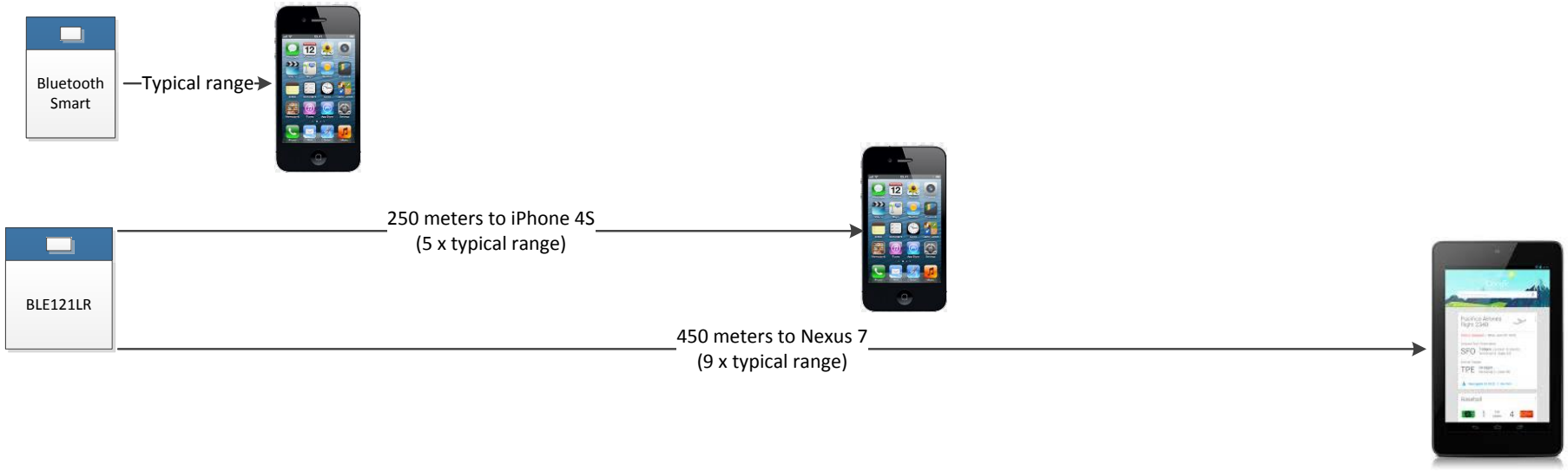
Benefits



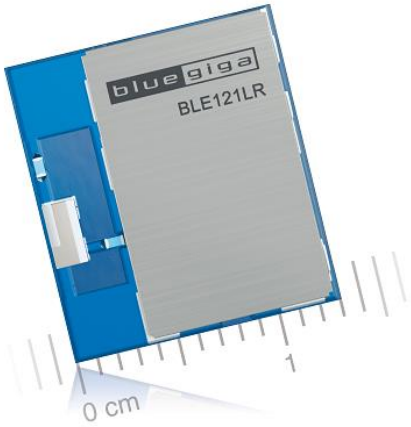
- **World Leading Radio Performance**
  - +8dBm TX power and -98 dBm sensitivity
  - 5-10 x range compared to conventional *Bluetooth* Smart solutions
- **Application Hosting Capability**
  - Application code can be executed on the BLE121LR
  - No need for a separate micro controller
  - Programmable with Bluegiga BGScript™ or C
- **Flash Based**
  - On-the-Field firmware updates over UART or OTA
  - Application data can be stored on the flash
- ***Bluetooth*, CE, FCC, IC, Japan and Korea Qualifications**
  - Minimal qualification costs
  - Proven interoperability

Bluetooth Smart Software

- **World Leading Radio Performance**
  - 5-10 x range compared to conventional *Bluetooth* Smart solutions

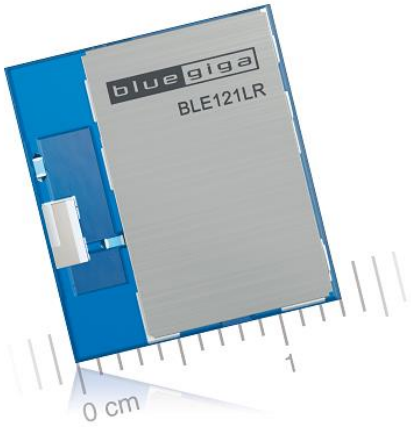


BLE121LR Overview



- ***Bluetooth* low energy radio**
  - Frequency: 2402 – 2480 MHz
  - TX power: +8 dBm
    RX sensitivity: -98 dBm
  - Modulation: GFSK
  - Symbol rate: 1 Mbps
- **Antenna**
  - Integrated ceramic chip
- **Measured Line-of-Sight Ranges:**
  - to iPhone 4S 250 meters
  - to Nexus 7 450 meters
  - to BLE121LR 450 meters

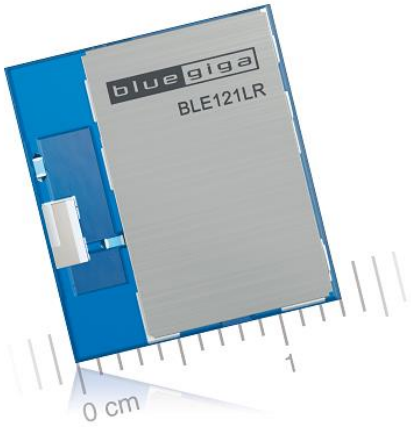
BLE121LR Overview



A total of 16 general purpose I/O pins

- **USART0**
  - SPI master/slave or UART 1Mbps
  - Hadware flow control
- **USART1**
  - SPI master/slave or UART 1Mbps
  - Hadware flow control
- **ADC**
  - 7 x ADC, 7-12-bit resolution
  - Internal temperature sensor
  - Internal battery monitor
- **I2C**
  - Low power, full speed I2C
- **GPIO**
  - Software programmable GPIO
- **PWM**
  - Up to 4 channel PWM

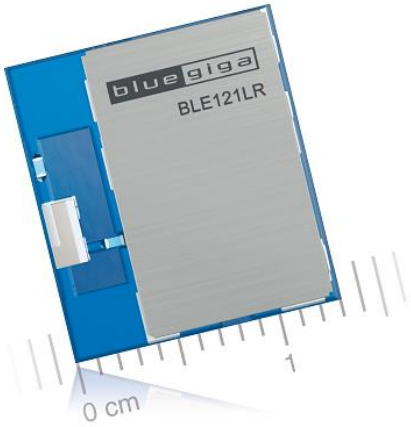
BLE121LR Overview



A programmable 8051 microcontroller

- **Architecture**
  - 8-bit, 8051 architecture
- **SRAM**
  - 8 kB
  - 1.5 to 4kB free for applications
- **Flash**
  - 256kB
  - 158kB free for application and/or OTA firmware updates

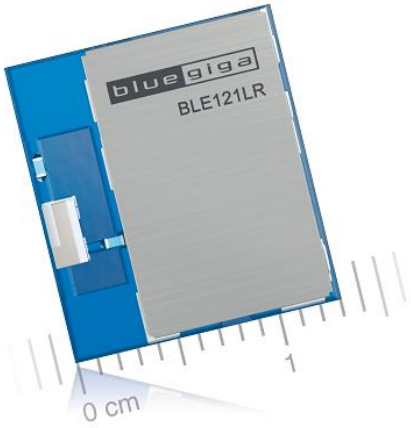
BLE121LR Overview



BLE121LR current consumption

- **TX peak**
  - 36 mA (8 dBm)
  - 25 mA (8 dBm + DC/DC)
- **RX peak**
  - 25 mA
  - 17.5 mA (with DC/DC)
- **MCU**
  - 250uA/Mhz
  - 8 mA peak consumption
- **Sleep modes:**
  - 270 uA (power mode 1)
  - 1 uA (power mode 2)
  - 0.5 uA (power mode 3)

BLE113 vs. BLE121LR

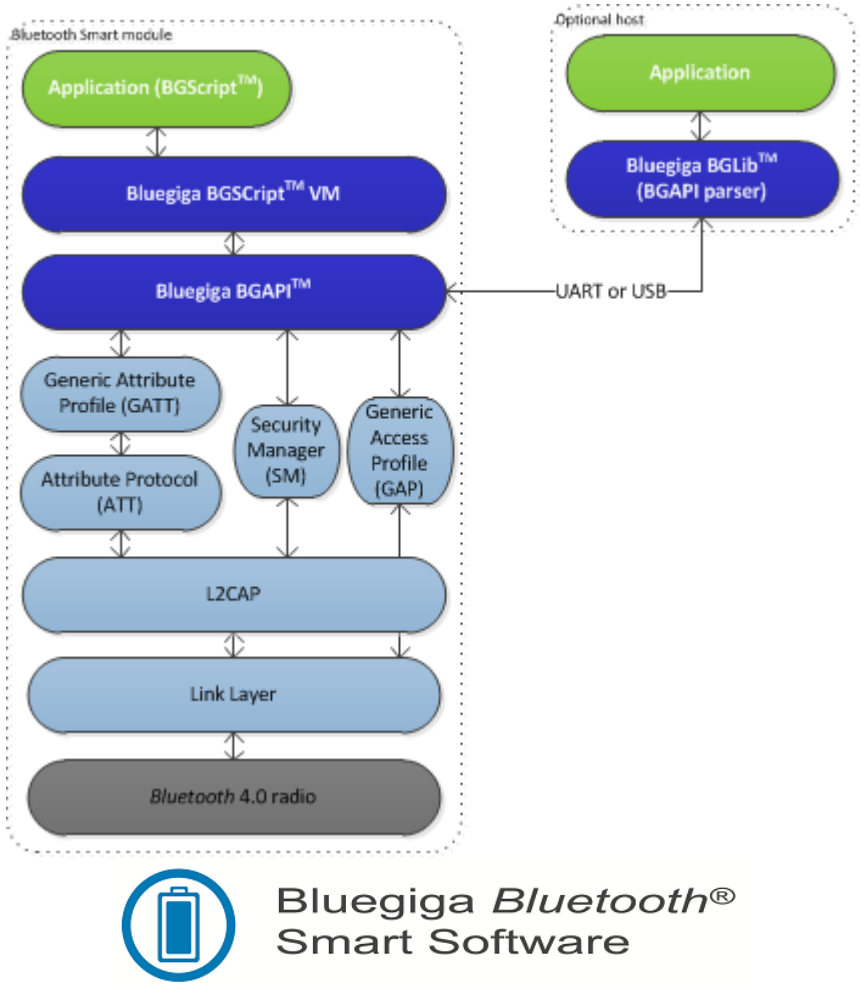


- **TX power**
  - BLE113 0 dBm
  - BLE121LR 8 dBm
- **Current consumption**
  - BLE113 20.7mA (0 dBm)
  - BLE121LR 36 mA (8 dBm)
- **Physical size**
  - BLE113 15.75 x 9.15 x 2.1 mm
  - BLE121LR 14.7 x 13.0 x 1.8 mm

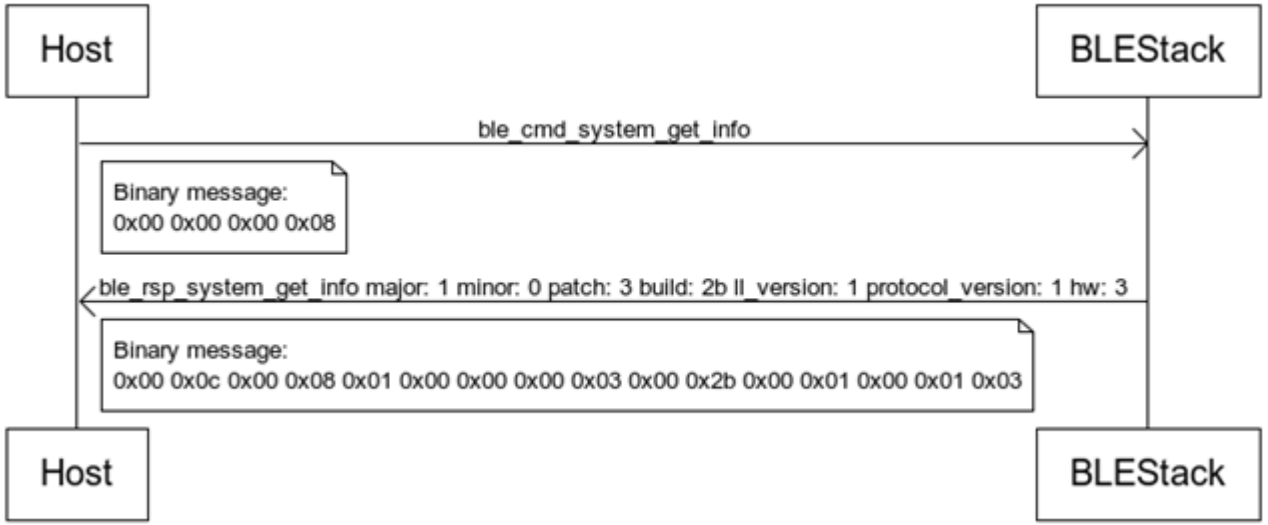
Bluetooth® Smart Software

Bluetooth Smart Software

- ***Bluetooth* v.4.0, Single Mode Compliant**
  - Supports master and slave modes
  - Up to 8 simultaneous connections
- **Implements all *Bluetooth* Smart Functionality**
  - GAP, L2CAP, ATT, GATT
  - Security manager: bonding, encryption
  - *Bluetooth* Smart profiles
- **Simple API for External Host Processors**
  - BGAPI™ : A simple protocol over UART or USB interfaces
  - BGLib™ : A C library for host processors implementing BGAPI
- **Supports Integrated Applications**
  - BGScript™ : A simple scripting language for writing applications
  - Native C application development with IAR Embedded Workbench
  - **No separate host needed**
- **DFU and OTA Firmware Upgrade Support**
- **Blutoooth Smart Profile Toolkit™**
  - XML based development tool for Bluetooth Smat profiles
  - Fast and simple profile development
- **Small Memory Requirements**
  - ~4-6 kB RAM
  - ~60-90 kB flash (depending of used features/profiles)
- ***Bluetooth* Qualified**



- **BGAPI™ 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 BLE121LR over UART
  - Very small memory requirements size requirement and low implementation overhead



Bluetooth Smart Software

- **BGLib™ library** : A portable ANSI C library, which implements the BGAPI protocol
  - Easy to port to various architectures such as : ARM Cortex, PIC16/32 etc.
  - Ported to multiple programming languages : ANSI C, Java, Python and C#
  - Uses fuction–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 very simple BASIC-like application scripting language
  - Used when applications are implemented on the BLE121LR's 8051 controller
  - Enables very fast application development and allows programs to be executed directly on the BLE121LR without the need of 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 to Use BGScript?

- **Very Simple to Use**
  - Fast development of simple *Bluetooth* Smart applications
  - Most appölications 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
  - Over-the-Air firmware update
  - iOS and Android applications

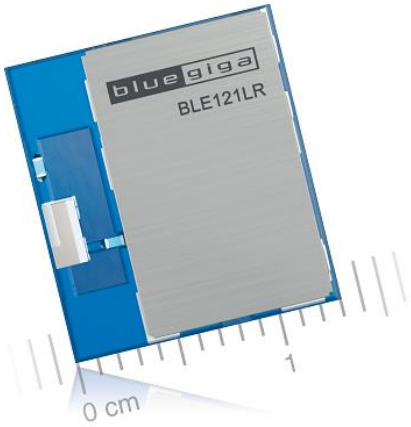
- **Cuts out the need for external MCU**
  - Reduced eBoM
  - Smaller footprint
  - Faster time-to-market

Bluetooth Smart Software

- ***Bluetooth* Smart Profile Toolkit™**: A tool for creating *Bluetooth* Smart profiles
  - *Bluetooth* Smart profiles are very simple
  - Can be describes with a single file of XML
  - Profile toolkit is a Simple XML description template for *Bluetooth* Smart Profiles
- **Several example profiles and services available**
  - Heart Rate transmitter
  - Proximity reporter
  - Blood glucose sensor
  - iBeacon
  - etc.

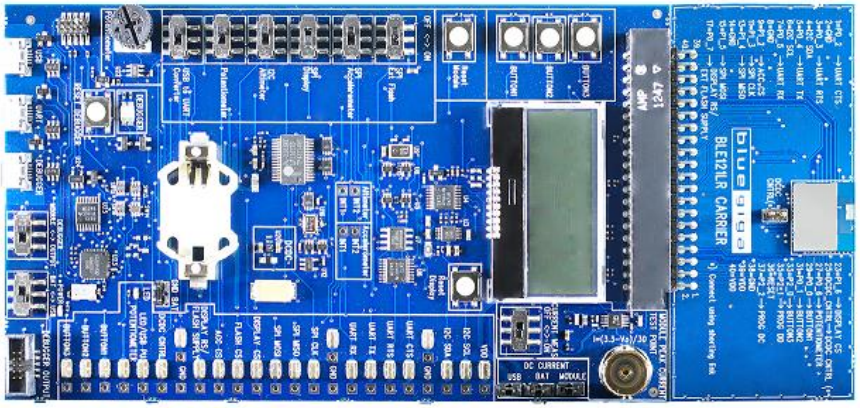
```
<service uuid="1800">
  <description>Generic Access Profile</description>

  <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>
```

Certifications



- ***Bluetooth* 4.0**
  - BLE121LR: 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

Development Tools



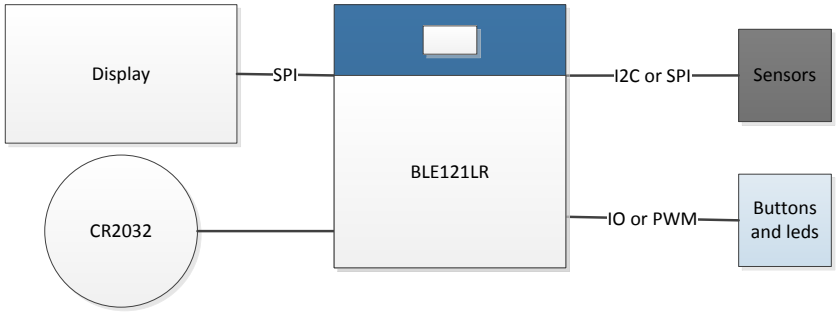
- **DKBLE Development Kit with**
  - Display
  - On-board accelerometer
  - On-board altimeter
  - Potentiometer
  - CR2032 battery holder
  - USB and RS232 interfaces
  - On-board firmware programming
  - Current measurement point
  - External DC/DC converter
  - I/O headers
  - Built-in extenral SPI flash

  + BLE121LR, BLE112-A, BLE113-A and BLE113-A-M256K carrier boards
  + BLED112 USB dongle

- ***Bluetooth* Smart SDK**
  - BGAPI™ documentation
  - BGScript™ development tools
  - BGLib™ source code
  - Profile Toolkit™
  - BGScript and BGLib examples
  - Profile examples
  - Documentation
  - iOS and Android example applications

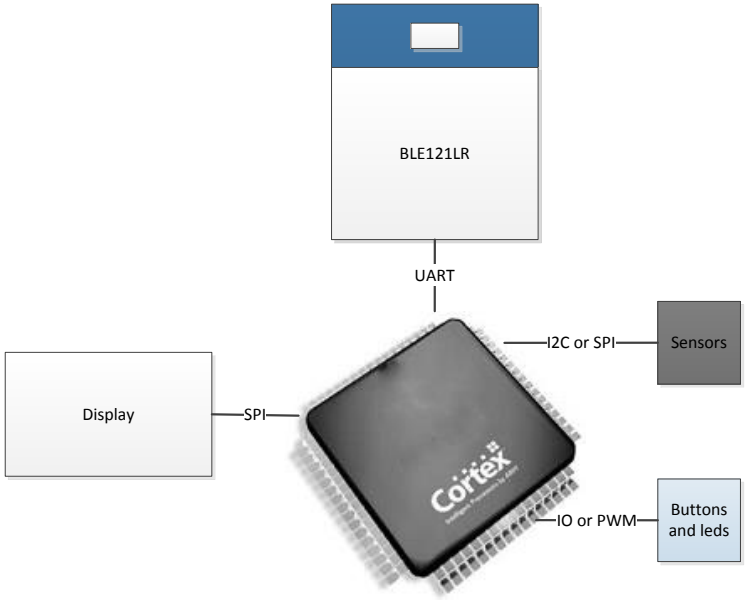
Use Cases

- **Standalone architecture**: No separate host processor
  - Sensors and peripherals are directly connected to the BLE121LR via the IO interfaces
  - Application executed on the on-board 8051
  - Application developed with BGScript™ or ANSI C and services and profiles with Profile Toolkit™



Use Cases

- **Hosted architecture**: A separate MCU is used
  - Sensors and peripherals are directly connected to the MCU via the IO interfaces
  - BLE121LR connected to the MCU via UART or USB
  - Application developerd to the MCU and interfacing to BLE121LR done using BGAPI™ protocol (BGLib™ can be used on the host)
  - Profile developed with Profile Toolkit™



Thank You