

Product Specification

Bluetooth v4.0 BLE Single Mode Module

[Generic & Security Tag Version]

BL-4011

Version: 1.2

Revision History

Edition #	Reason for revision	Issue Date
1.0	Initial Document	2012/12/03
1.1	Add Security Tag	2012/12/23
1.2	Modify RF Spec and w/EEPROM	2013/6/14

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Technical Support Contact Information

If you encounter any technical issues while using BL-4011, do not hesitate to contact us @AtechOEM. Our technical staff will help you resolve the technical issues. You can contact us by email or phone. The following is our technical contact:

- Hours: 9:30AM to 5:30PM (GMT+08:00)
- Email: wifi.support@atechtpe.com.tw
- Phone: +886.2.2377.0282

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1. Overview

BL-4011, Bluetooth low energy (BLE) single mode module is targeted for low power sensors and accessories. It offers GATT profile as the based lower profile. We could also provide other standard BLE profiles such as proximity, find me ... etc. The module provides flexible hardware interfaces to connect sensors, simple user interfaces – AT commands.



The single mode radio enables it to connect to the dual mode Bluetooth products already in the market, as well as other Bluetooth low energy devices/ sensors. It can be used in equipments like a heart rate sensors, pedometers, watches, blood pressure meters, weight scales, households sensors, collector devices, security tags, wireless keys, proximity sensors, HID keyboards and mice.

It can be powered directly with 1.8V ~ 3.6V power source, such as a standard 3V coin cell battery. BL-4011 only consumes a little energy in different sleep mode, for example 780nA in lowest power sleep mode.

AtechOEM provides a proprietary GATT-based profile to our customers. The profile is similar to the classic SPP (Serial Port Profile) described in Bluetooth v2.1. Customers could use this special profile to transfer raw data between GATT-based connection in their application. AtechOEM also offer **customized firmware services** to meet specific applications more tightly.

1.1. Model

Following Table shows the different models in BL-4011 series.

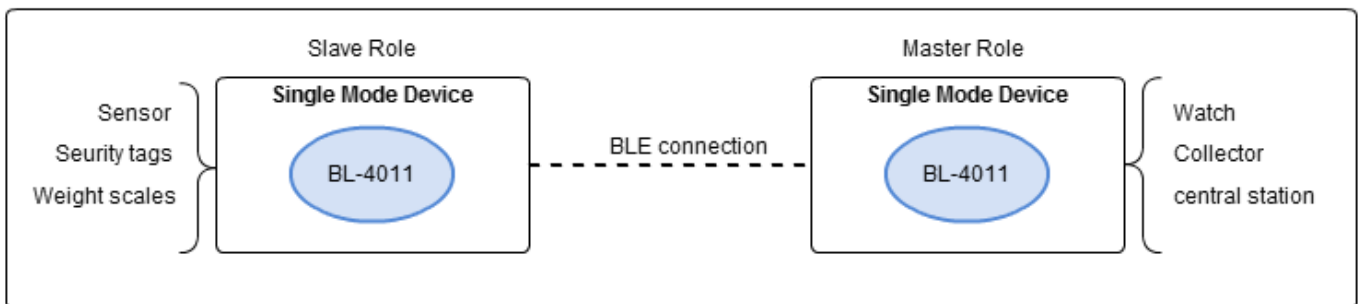
BL-4011A	BL-4011E	BL-4011N
Chip antenna on board	U.FL connector	RF Pin Out
		

2. Typical Applications

- Home automation
- Sports & fitness
- Health care & Consumer wellness
- Sensors & Controls
- Industrial automation
- Security & Proximity
- Mobile phone accessories
- Small data transferring

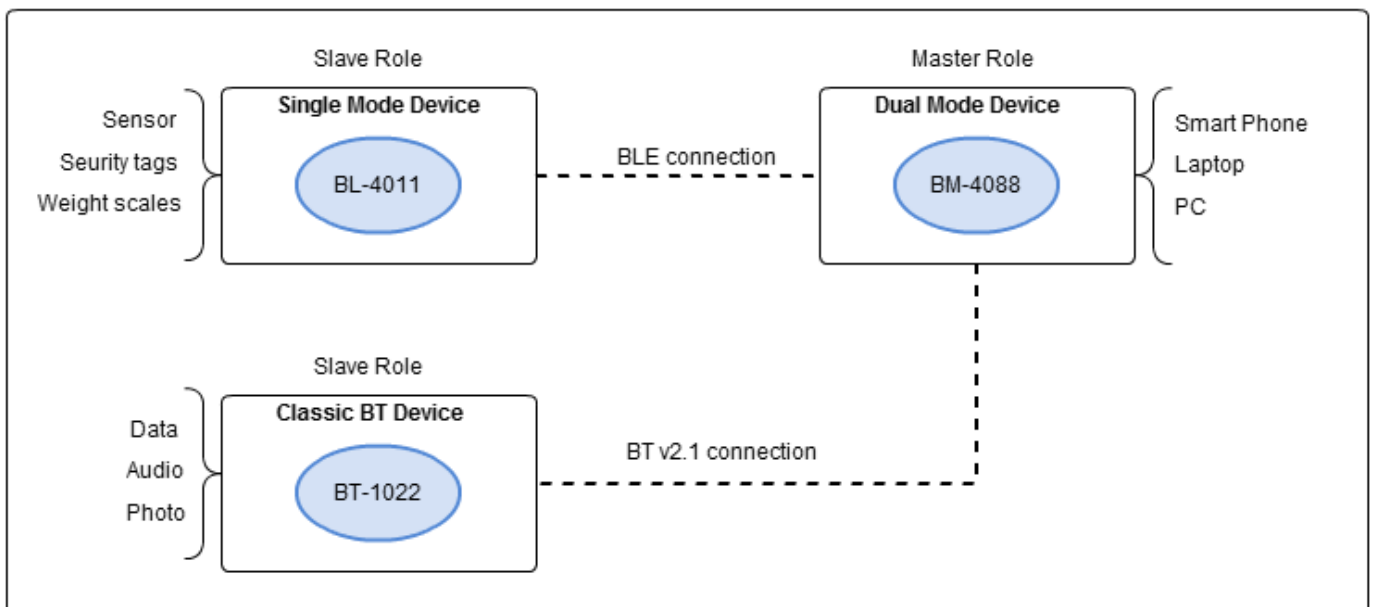
■ Single Mode Connection Logical Diagram

Following diagram describes how to use BL-4011 in an application.



■ Single/Dual Mode Connection Logical Diagram

Following diagram describes how to use BL-4011 and other Bluetooth modules in an application.



3. Product Information

■ Product Number : **BL-4011**

■ Product Description: **Bluetooth v4.0 Single Mode Flash Module**

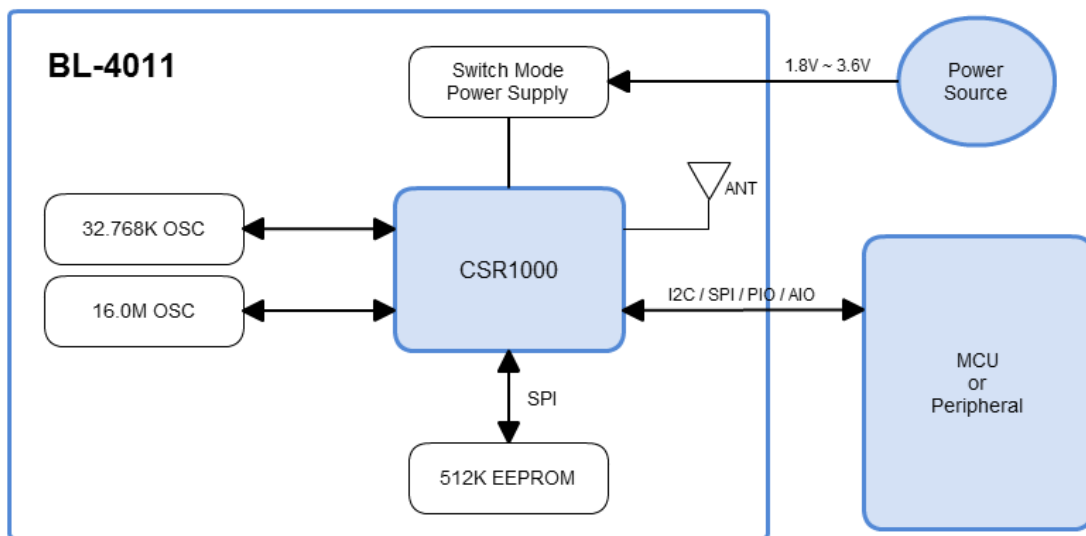
■ Product Features:

Chip	CSR1000
Standard	Bluetooth v4.0 Single mode / BLE
EEPROM	512Kbits
RF band	2.4~2.4835GHz ISM band
Host Interface	UART
Debug Interface	SPI
Digital Interface	UART / GPIO / I2C
Analog Interface	AIO
RF Output Power	Up to 8.5dBm Typically
Sensitivity	>-93dBm
Antenna	Chip Antenna / U.FL connector / RF Pin Out
Power voltage	1.8 V ~ 3.6V
Dimension	20.7mm x 12.6mm x 1.7mm

4. Hardware

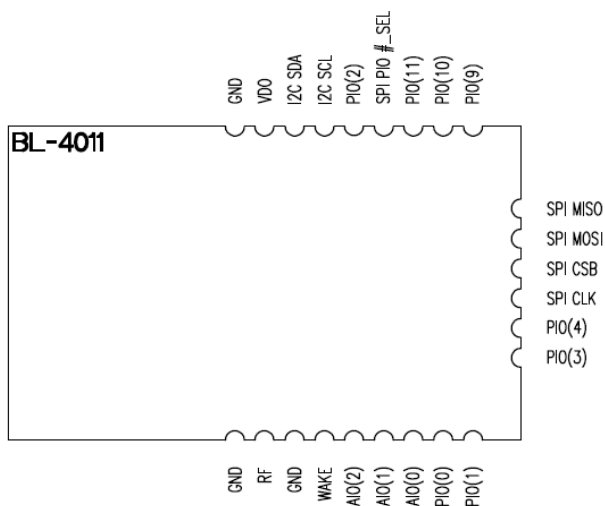
BL-4011 is a surface-mount module designed to be integrated to a system board as a Bluetooth low energy subsystem or standalone system. The power supply ranges from 1.8VDC to 3.6 VDC, so it is suitable for battery application. Digital data (PIO) and analogue interface (AIO) are supported in BL-4011. Following sections describe all hardware specifications and application reference.

4.1. Block Diagram



4.2 Pin Assignment:

The following picture shows pinouts of BL-4011 from the top of the module.

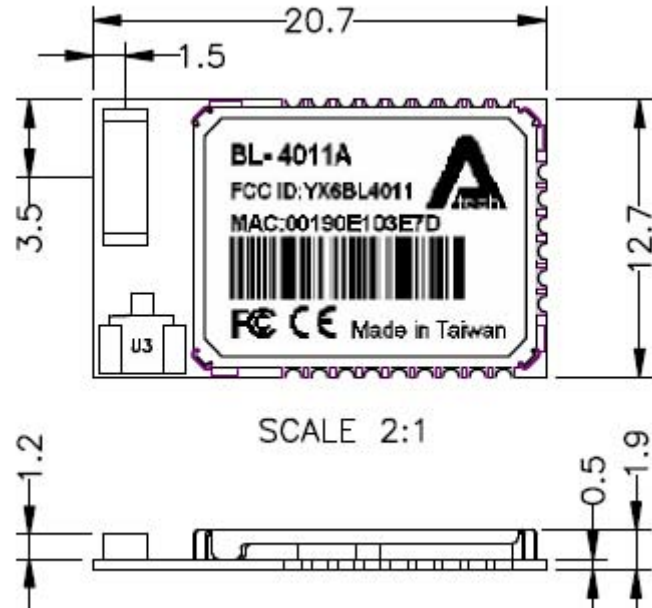
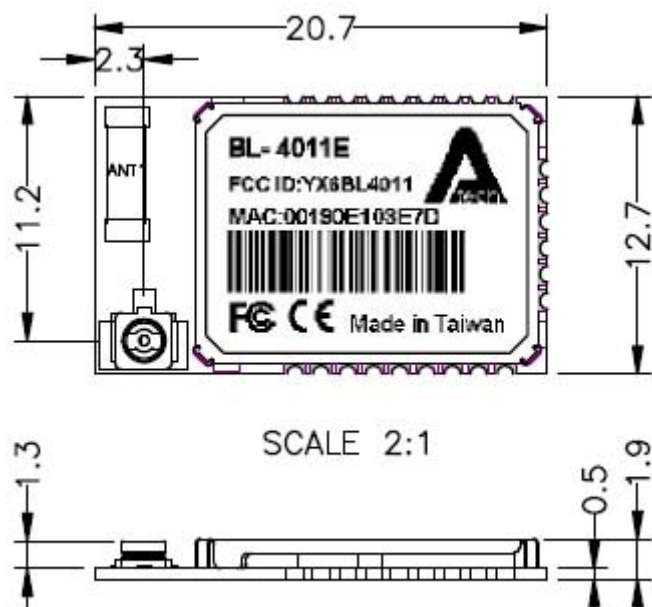


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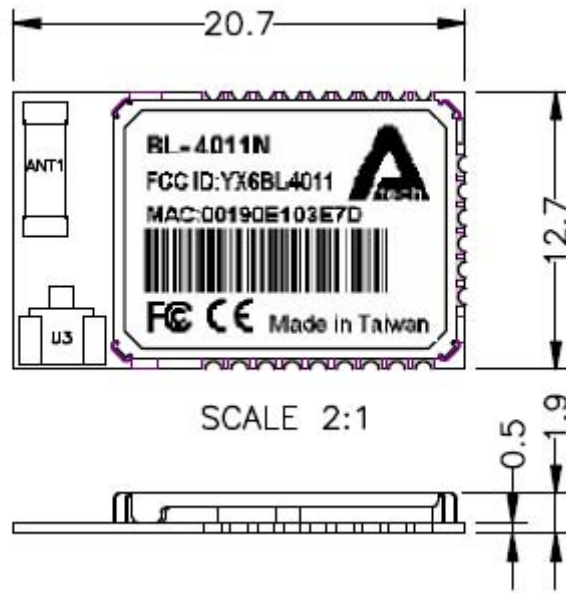
4.3 Pin Definition:

Pin	Name	Type	Note
1	GND	Passive	Ground
2	RF	In/Out	RF Port
3	GND	Passive	Ground
4	WAKE	In	Wake up BL-4011 If in Hibernate or Dormant mode.
5	AIO2	In/Out	Analog I/O
6	AIO1	In/Out	Analog I/O
7	AIO0	In/Out	Analog I/O
8	PIO0 / UART Tx	In/Out	General Purpose I/O
9	PIO1 / UART Rx	In/Out	General Purpose I/O
10	PIO3	In/Out	General Purpose I/O
11	PIO4	In/Out	General Purpose I/O
12	SPI CLK	In/Out	Internal Testing Use
13	SPI CSB	In	Internal Testing Use
14	SPI MOSI	Out	Internal Testing Use
15	SPI MISO	In	Internal Testing Use
16	PIO9	In/Out	General Purpose I/O
17	PIO10	In/Out	General Purpose I/O
18	PIO11	In/Out	General Purpose I/O
19	SPI / PIO # SEL	In	Function Selection
20	PIO2	In/Out	General Purpose I/O
21	I2C SCL	In/Out	I2C Clock In/Out
22	I2C SDA	In/Out	I2C Data In/Out
23	VDD	Power	Main Power Supply
24	GND	Passive	Ground

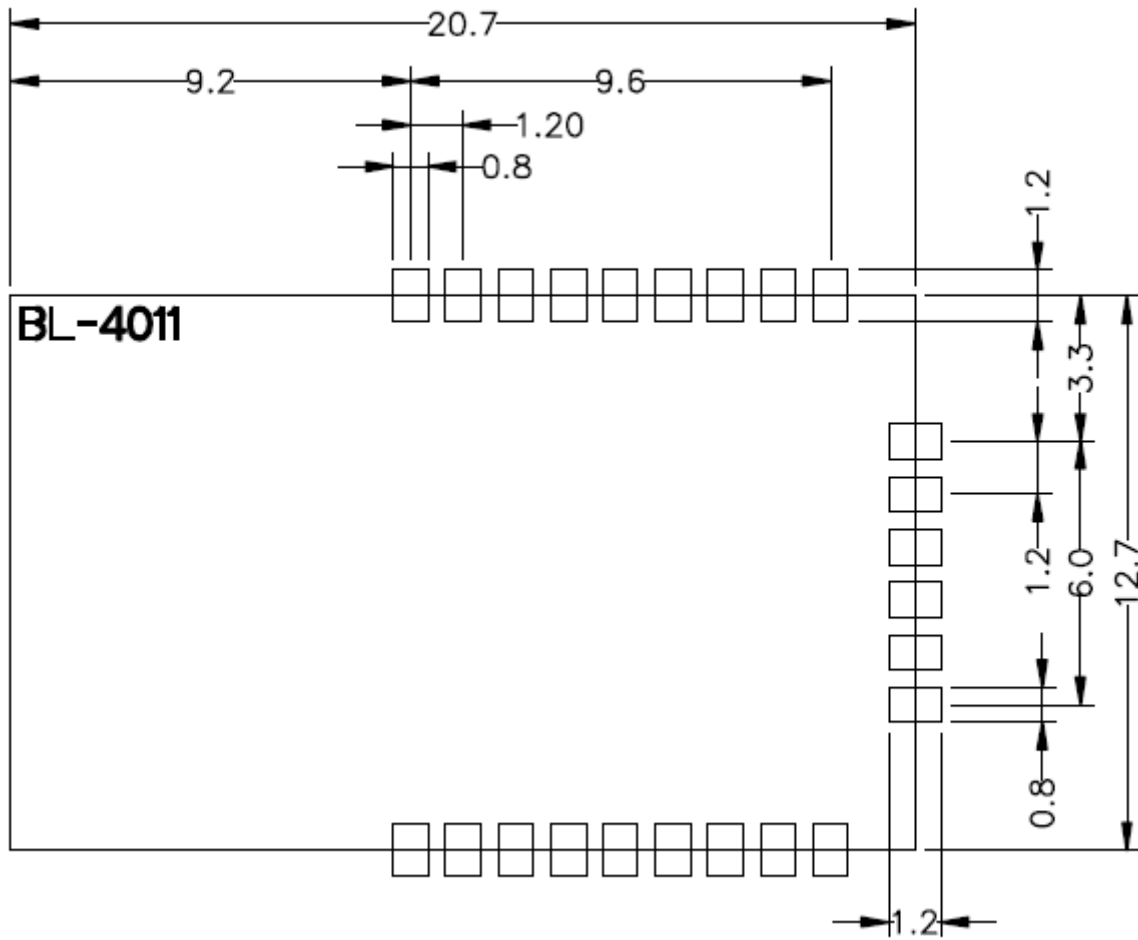
4.4. Mechanical Specification

<p>BL-4011A</p>	 <p>Top view dimensions: 20.7 (width), 1.5 (offset), 3.5 (height), 12.7 (module height).</p> <p>Side view dimensions: 1.2 (height), 0.5 (thickness), 1.9 (total thickness).</p> <p>Text on module: BL-4011A, FCC ID: YX6BL4011, MAC: 00190E103E7D, Made in Taiwan.</p> <p>SCALE 2:1</p>
<p>BL-4011E</p>	 <p>Top view dimensions: 20.7 (width), 2.3 (offset), 11.2 (height), 12.7 (module height).</p> <p>Side view dimensions: 1.3 (height), 0.5 (thickness), 1.9 (total thickness).</p> <p>Text on module: BL-4011E, FCC ID: YX6BL4011, MAC: 00190E103E7D, Made in Taiwan.</p> <p>SCALE 2:1</p>

BL-4011N



4.5. PCB Layout Footprint



4.6. Electrical Characteristics

	Min	Typ.	Max.	Unit
Supply Voltage	1.8	3.3	3.6	V
Normal Standby @ 3.3V	-	1.39	-	mA
TX (Normal mode) @ 3.3V	-	-	22.77	mA
RX (Normal mode) @ 3.3V	-	-	20.88	mA
Shallow Sleep @ 3.3V	-	-	486	uA
Deep Sleep @ 3.3V	-	-	4.9	uA
Hibernate Sleep @ 3.3V	-	-	1.9	uA
Dormant Sleep @ 3.3V	-	-	900	nA

■ Operating Conditions

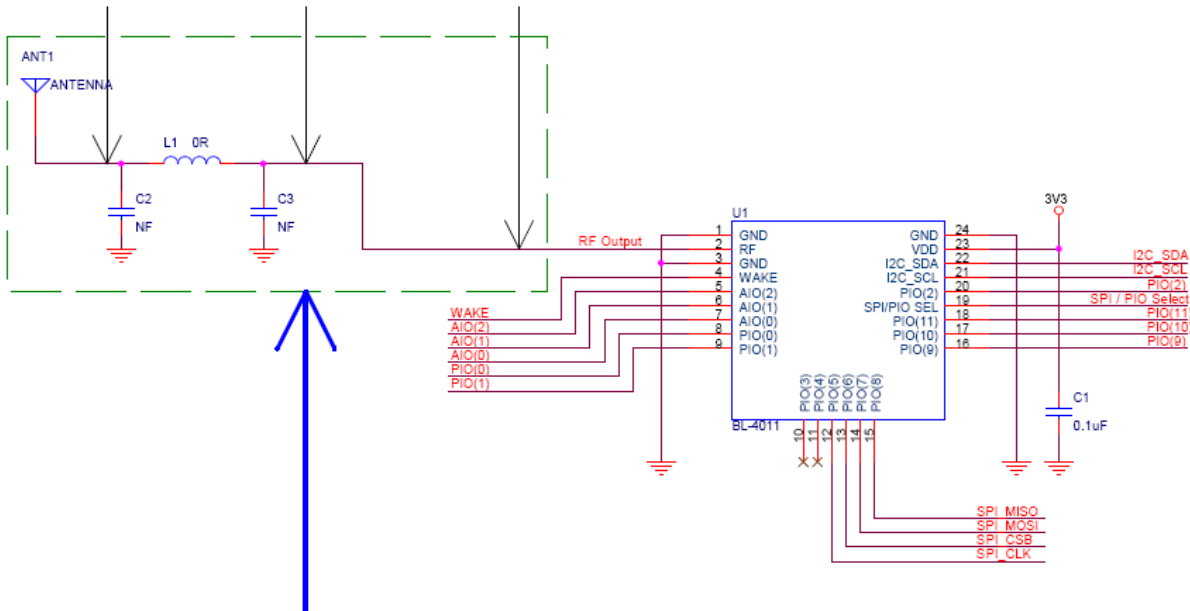
Voltage Range	1.8V ~ 3.6V
Operating Temperature Range	-30 °C ~ 85 °C
Storage Temperature Range	-40 °C ~ 85 °C
Relative Humidity (Operating)	≤90%
Relative Humidity (Storage)	≤90%

4.7. Radio Characteristics

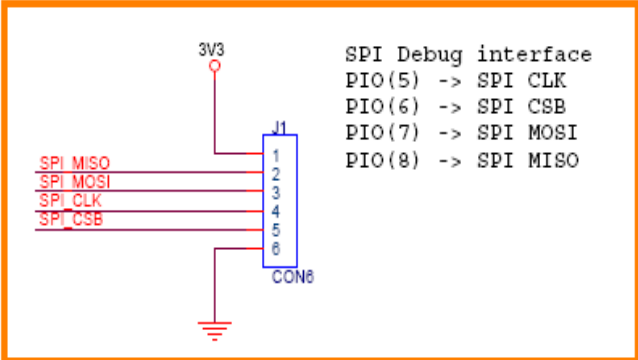
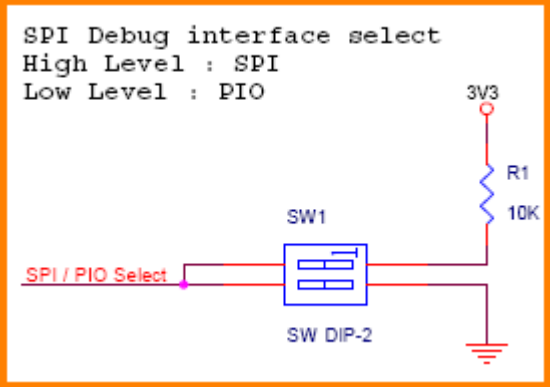
	Frequency (GHz)	Min	Typ	Max	BT Spec.	Unit
Tx Output Power (Average)	2.402	-	8.56	-	-20 ~ 10	dBm
	2.440	-	8.99	-		dBm
	2.480	-	8.99	-		dBm
Rx Sensitivity (FER)	2.402	-	-92	-	<=-70	dBm
	2.440	-	-92	-		dBm
	2.480	-	-92	-		dBm
Carrier Frequency Offset	2.402	-	±10	-	±150	kHz
	2.440	-	±10	-		kHz
	2.480	-	±10	-		kHz
Maximum Input Level	2.402	-5			FER <= 30.800 %	dBm
	2.440					
	2.480					
Modulation Characteristics (F1)	2.402	-	253.5	262.5	225 <	kHz
	2.440	-	260.2	265.3	F1avg	kHz
	2.480	-	255.9	262.6	< 275	kHz
Modulation Characteristics (F2)	2.402	-	225.8	214.3	>= 185	kHz
	2.440	-	228.2	211.4		kHz
	2.480	-	222.7	211.1		kHz
PER Report Integrity	Cycle 1	-	50	-	50.0 <= PER <= 65.4	%
	Cycle 2	-	50	-		%
	Cycle 3	-	50	-		%
Antenna Gain	-	-	0.5	-	-	dBi

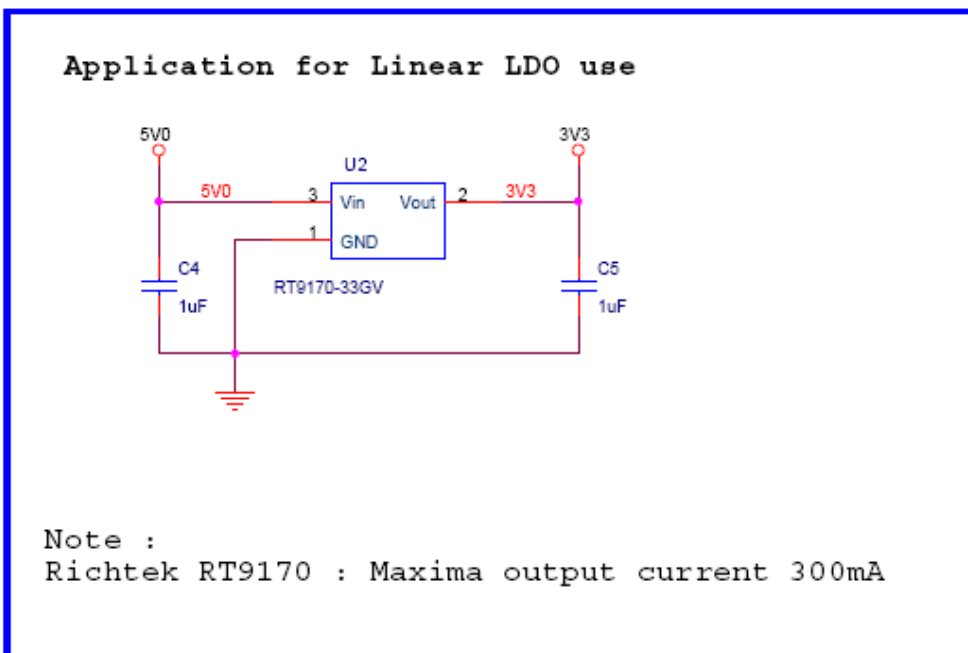
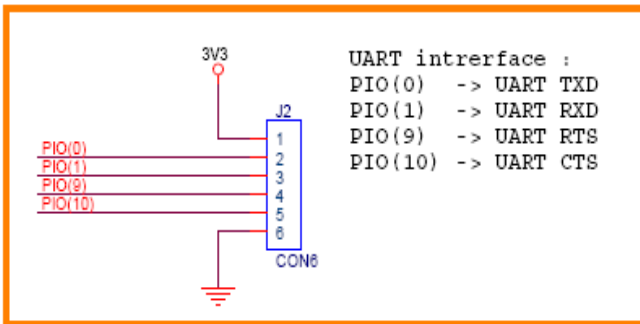
4.8. Application Circuit

The thickness of this RF trace should meet 50ohm impedance
 # Only for RF Feed type use



If you use the Chip antenna or Ipex RF type ,
 you don't need to place those related components
 and route any RF trace .





Signal & Function

WAKE : Wake up the system from sleep or sniff mode
 AIO[0-2] : Analog signal In and Output
 PIO : Programble In/Out
 I2C : Inter-Integrated Circuit

Note :

PIO(3) and PIO(4) has been used by internal 2Mbit Flash

5. Software & Operation Mode: Data-Transfer Profile

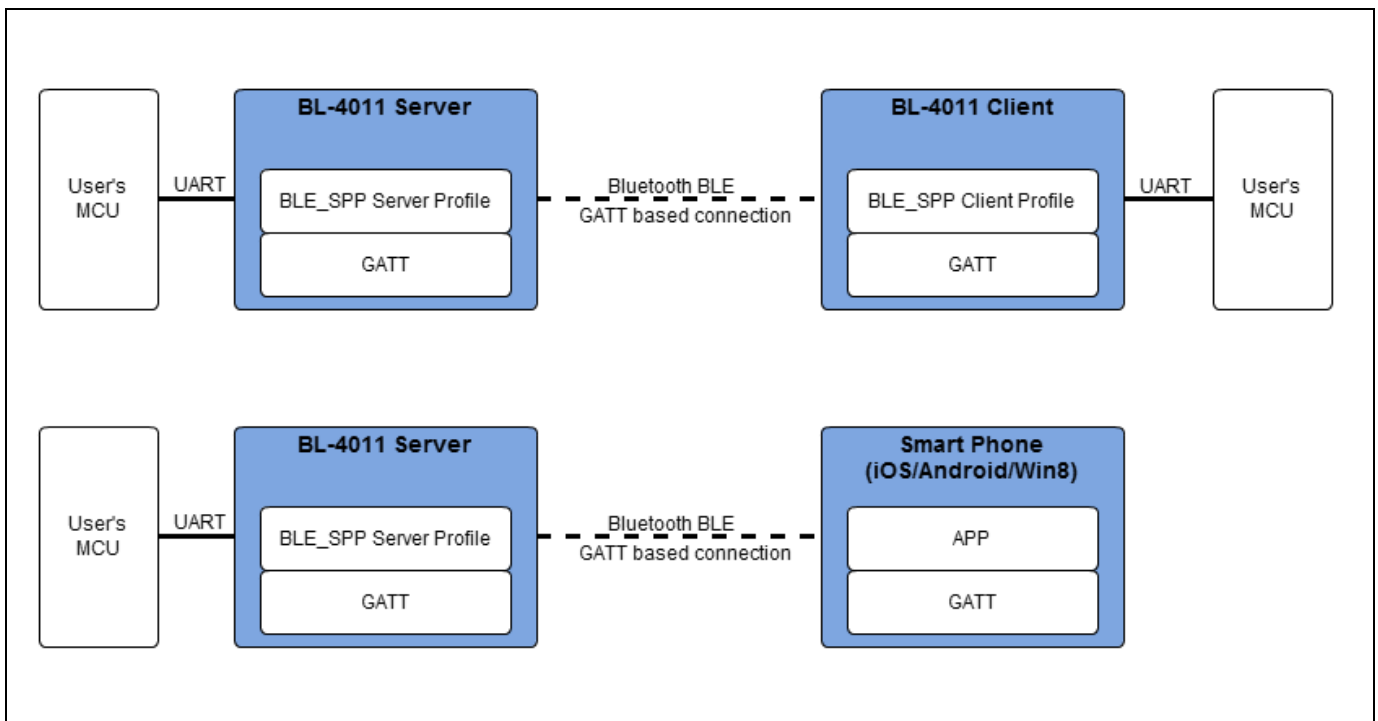
The special firmware in BL-4011 supports two different operation modes: **Client mode** and **Server mode**. This special firmware allows BL-4011 to transfer data through the UART interface, which is similar to the **SPP profile** in Bluetooth v2.1 standard.

BL-4011 with Client-mode firmware can initiate the connecting process between client and server. With Server-mode firmware, BL-4011 can advertise its information and wait for the client's connecting.

AtechOEM also can provide standard GATT-based profiles issued in Bluetooth SIG. We also provide customized firmware to our customers to apply to different applications.

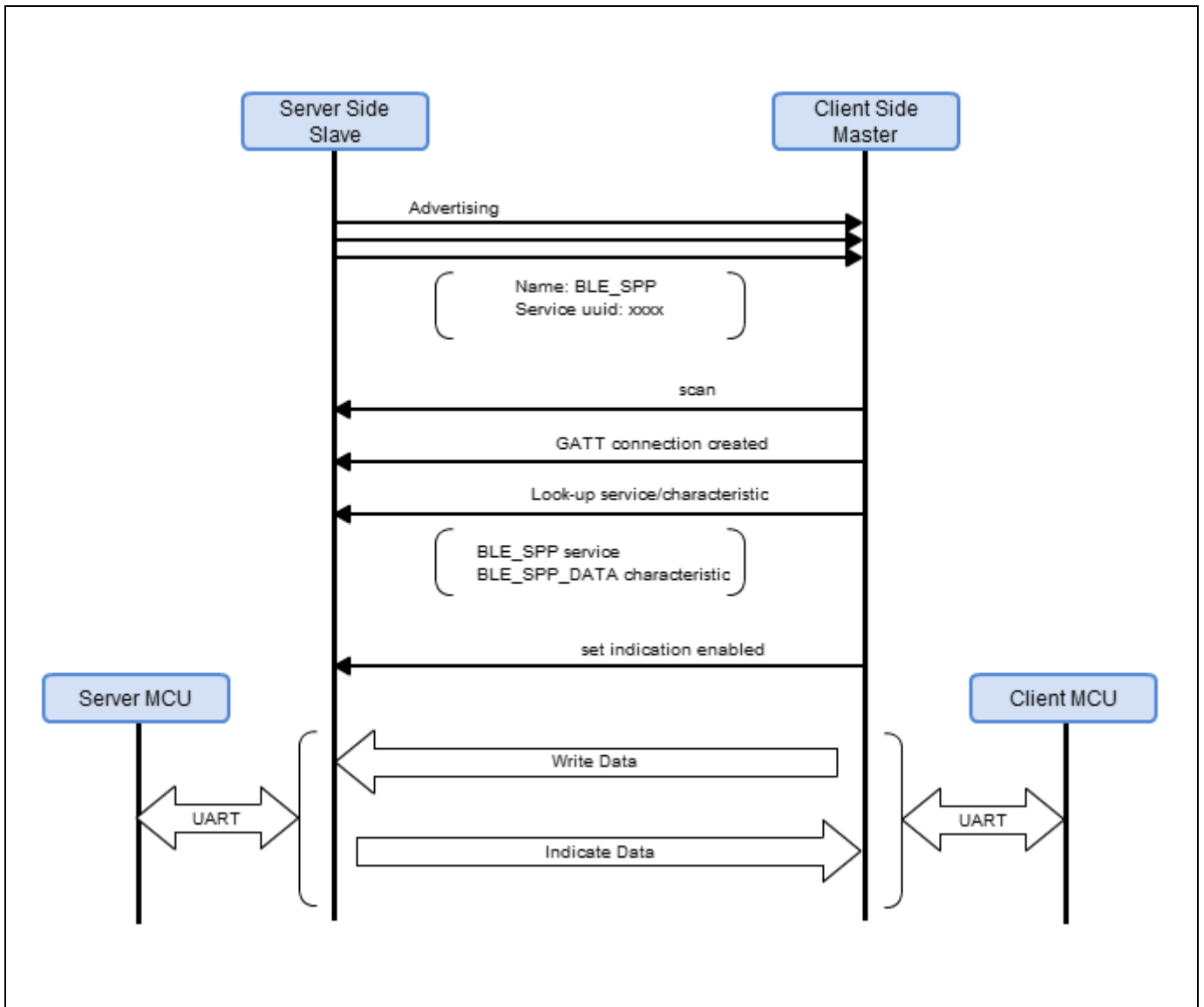
5.1. Application Architecture with Client-mode and Server-mode

Application architecture of BL-4011 with Client and Server mode is showed as below. The Client-mode also can be connected by an smart phone based on GATT connection. The data can be transferred through an UART interface or an APP on a smart phone.



5.2. SPP Connection Example in AT-command mode

The following example describes simple connecting process between client and server mode in BL-4011.



5.3. Configuration in Server Mode

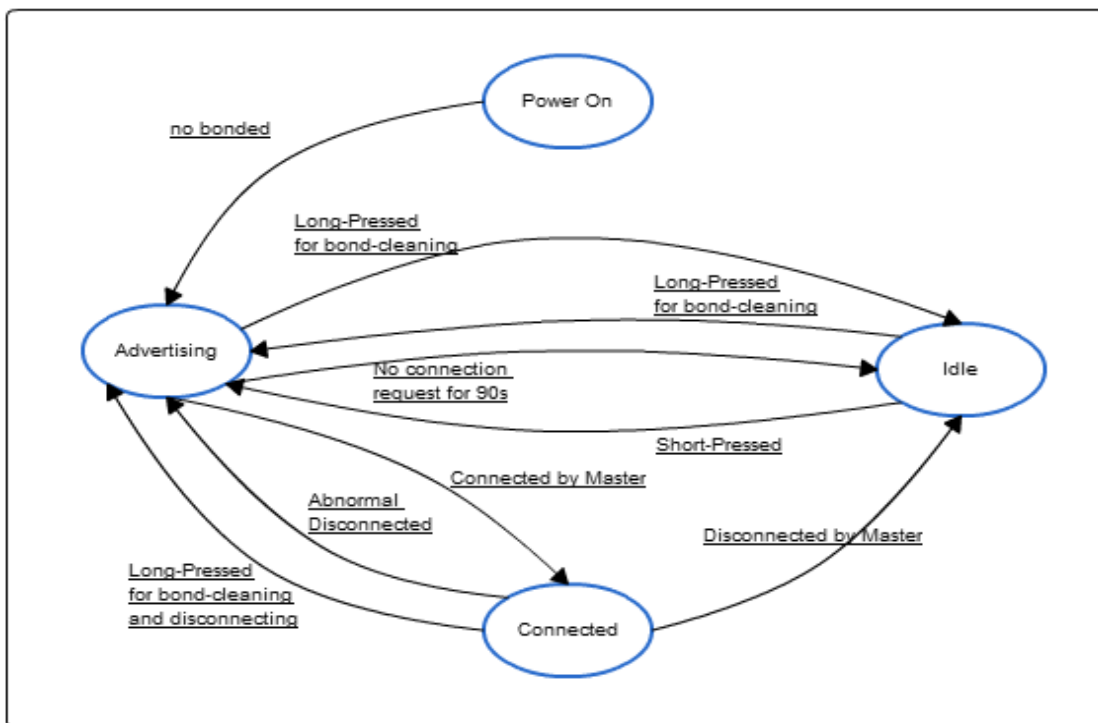
Default Configurations in Server Mode:

Bluetooth		UART	
Mode	Server Mode	Baud Rate	2400 bps
Profile	GATT / BLE_SPP (Private)	Data Bits	8
Device Name	BLE_SPP	Parity	No
BLE_SPP Service UUID	0x3a1bc6e0fb0611e1b9c20002a5d5c51b	Stop Bits	1
BLE_SPP_DATA characteristic UUID	0xcc330a40fb0911e1a84d0002a5d5c51b		

PIO Definition in Server Mode:

Pins	Type	Function	Descriptions
PIO10	Out	LED	Off (Low) => Idle On (High) => Connected Flash => Advertising
PIO 11	In	Button	Long Pressed => Pressed Low for 4 seconds (Active Low) Short Pressed => Pressed Low less than 4 seconds

State Machine in Server Mode:



5.4. Configuration in Client Mode

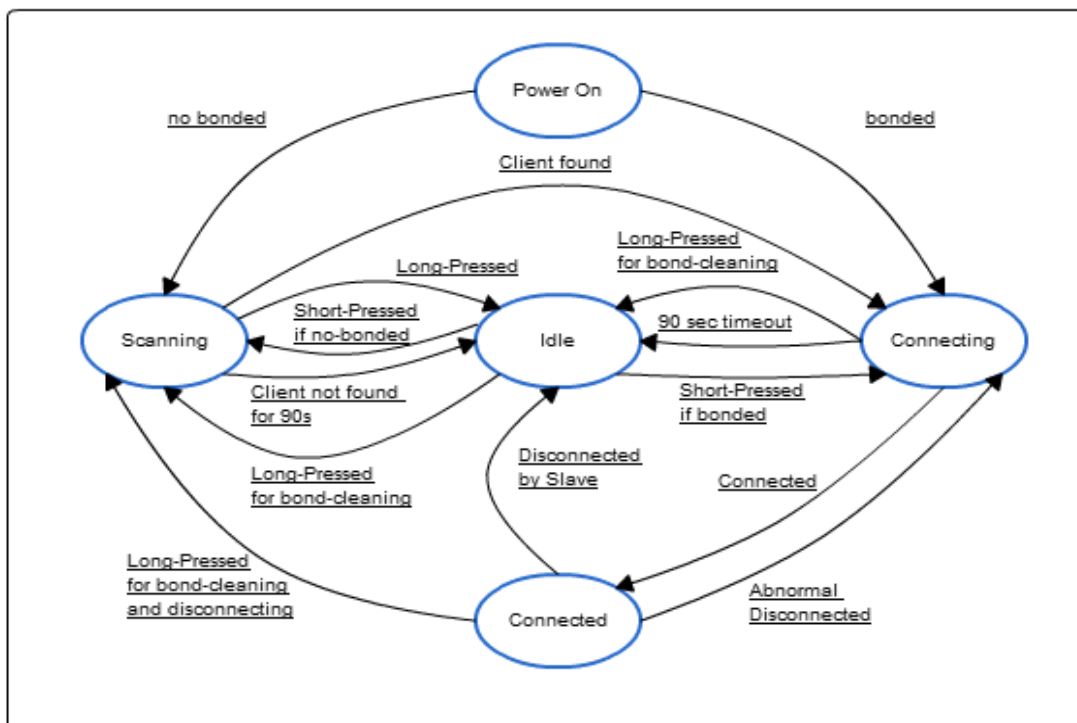
Default Configurations in Client Mode:

Bluetooth		UART	
Mode	Client Mode	Baud Rate	2400 bps
Profile	GATT	Data Bits	8
-	-	Parity	No
-	-	Stop Bits	1

PIO Definition in Client Mode:

Pins	Type	Function	Descriptions
PIO10	Out	LED	Off (Low) => Idle On (High) => Connected Flash => Scanning / Connecting
PIO 11	In	Button	Long Pressed => Pressed Low for 4 seconds (Active Low) Short Pressed => Pressed Low less than 4 seconds

State Machine in Client Mode:



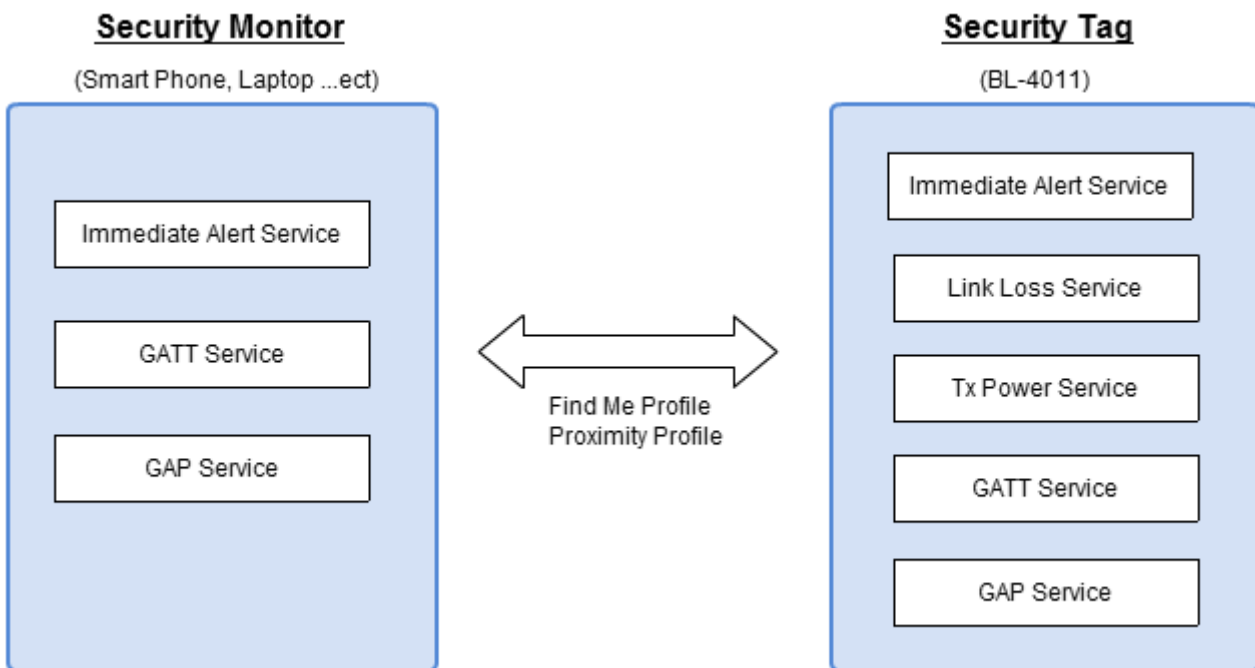
6. Security Tag Application: Find Me & Proximity Profile

The section describes the Security Tag application supplied with BL-4011. Security Tag application uses the Find Me and the Proximity profile which is specified by the Bluetooth SIG. These two profiles are standard profiles released by Bluetooth SIG.

Customers could use this firmware in their application. AtechOEM also can provide customized firmware to our customers to apply to different applications.

6.1. Application Overview

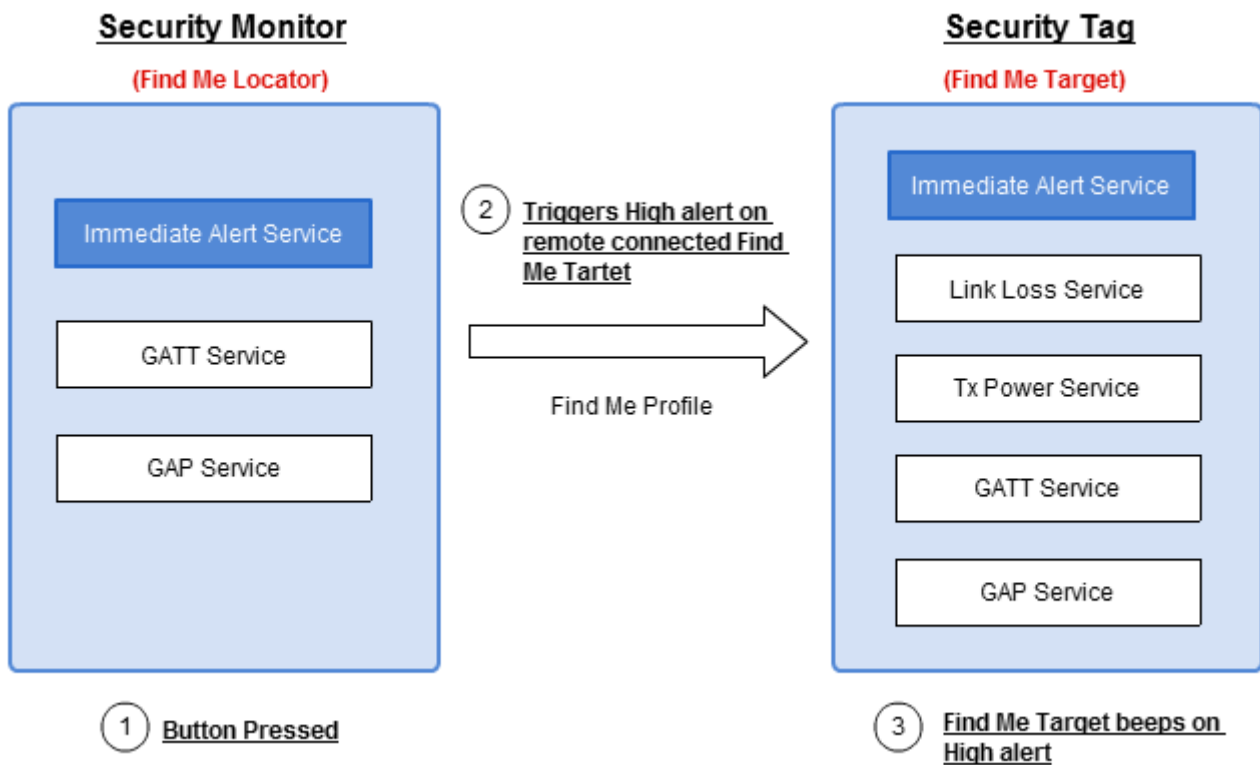
The following figure shows the Security Tag application consists of two devices – Security Monitor and Security Tag. They both have several services inside. The Security Monitor could be a smart phone, laptop or any other host equipments. The Security Tag is a device which has BL-4011 inside.



6.2. Find Me Profile

The Find Me profile defines the behaviour when a button is pressed on a device to cause an immediate alert on the remote connected device. This profile is used to locate devices.

The following figure shows how the Security Tag works with Find Me Profile.



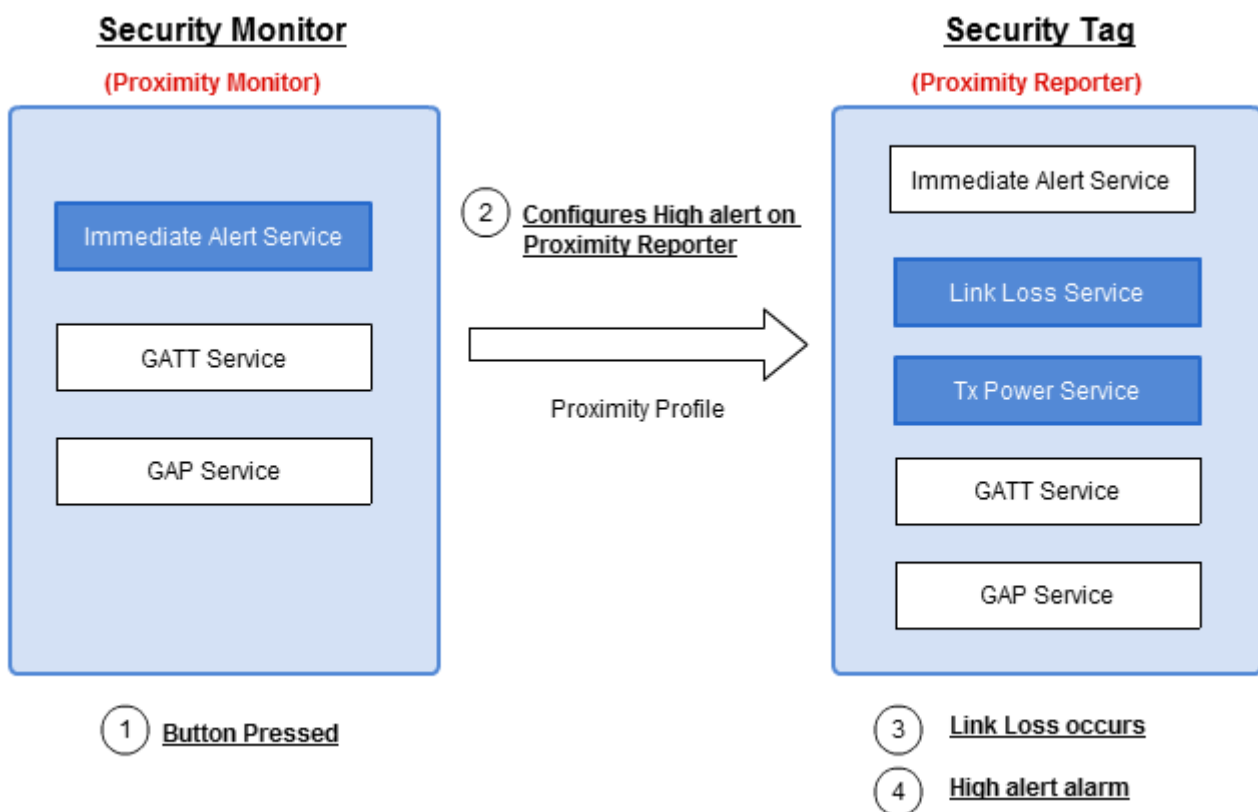
The Find Me profile defines two roles, see the following table:

Role	Description
Find Me Locator	Find Me Locator is the device that causes an immediate alert on the remote connected device.
Find Me Target	Find Me Target is the device that alerts when triggered by the remote connected Find Me Locator.

6.3. Proximity Profile

The Proximity profile defines the behaviour when a device moves away from a remote connected device so that the connection is dropped or the path loss increases above a preset level, causing an immediate alert. This alert can be used to notify the user that the device has been separated. As a consequence of this alert, a device may take further action, for example it may lock itself so that it is no longer usable.

The following figure shows how the Security Tag works with Proximity Profile.



The Proximity profile defines two roles, see the following table:

Role	Description
Proximity Reporter	Proximity Reporter is the device that alerts on link loss and optionally on path loss.
Proximity Monitor	Proximity Monitor is the device that configures the alert on the Proximity Reporter.

6.4. User Interfaces

The application makes use of the button, buzzer and LED available on BL-4011's PIO.

■ PIO Definition in Security Tag:

Pins	Type	Function	Descriptions
PIO3	Out	Buzzer	-
PIO4	Out	LED	-
PIO11	In	Button	Short pressed and Long pressed

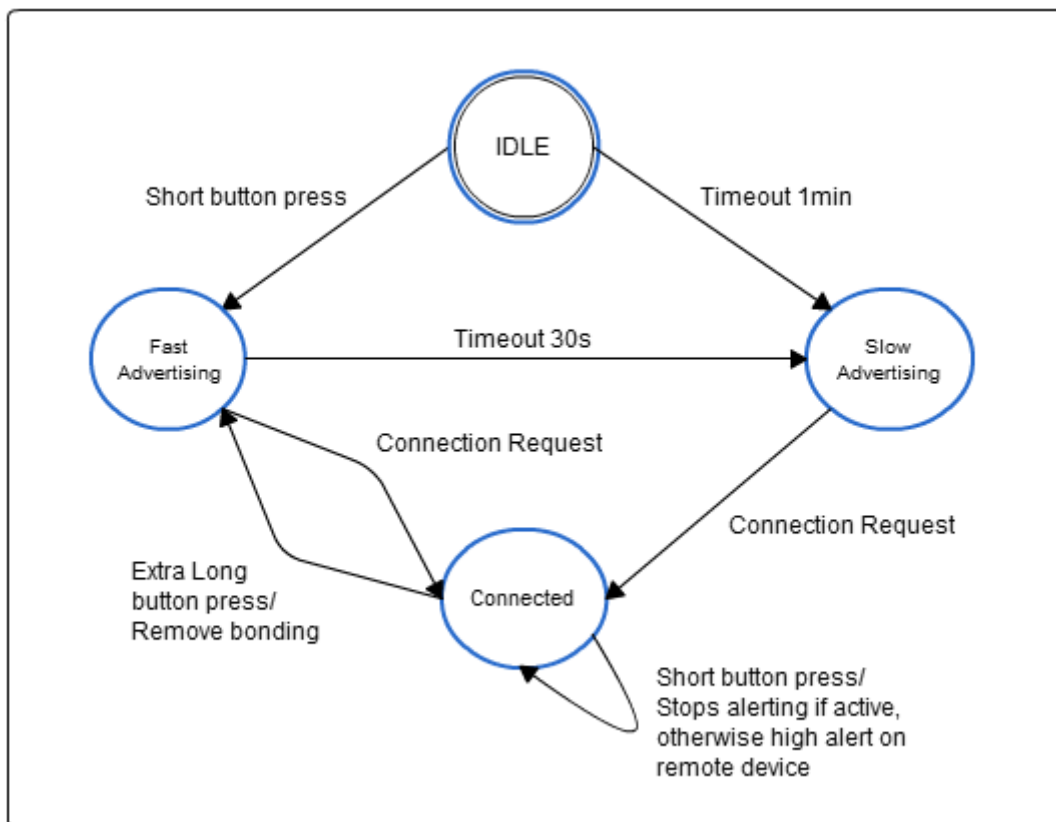
■ Button Behaviour:

In the Connected state, a **Short button press** stops the alert on the Security Tag if it is active; otherwise it triggers a **High alert** on the remote Security Monitor.

In Idle state, a **Short button press** triggers advertisements and registers the pending **High alert** information, which will be used to trigger a **High alert** on the remote Security Monitor once the connection is established.

An **Extra Long button press** by the user disconnects the link if any, removes bonding and starts advertising.

The following figure summarizes the Security Tag device behavior.



Federal Communication Commission Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- . Reorient or relocate the receiving antenna.
- . Increase the separation between the equipment and receiver.
- . Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- . Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: To assure continued compliance, any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. (Example - use only shielded interface cables when connecting to computer or peripheral devices).

End Product Labeling

This transmitter module is authorized only for use in devices where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in visible area with the following: "Contains FCC ID: YX6BL4011"

End Product Manual Information

The user manual for end users must include the following information in a prominent location "IMPORTANT NOTE: To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be colocated or operating in conjunction with any other antenna or transmitter." This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions (1) This device may not cause harmful interference and (2) This device must accept any interference received, including interference that may cause undesired operation.

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or colocation with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for reevaluating the end product (including the transmitter) and obtaining a separate FCC authorization. This device is intended only for OEM integrators under the following conditions: The antenna must be installed such that 20 cm is maintained between the antenna and users. As long as a condition above is met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end product for any additional compliance requirements required with this module installed (for

example, digital device emissions, PC peripheral requirements, etc.).