LBT1 LoRaWAN Bluetooth Tracker User Manual

Document Version: 1.1.1

Image Version: v1.0

Version	Description	Date
1.0	Release	2020-Nov-21
1.1.0	Add description of BLEMASK.	2021-Jan-12
1.1.1	Make payload description clearer	2021-Jan-22

1. Introduction

1.1 What is LBT1 LoRaWAN Bluetooth Tracker

LBT1 is a Long Range / low power consumption **LoRaWAN Bluetooth tracker**. LBT1 scans and find the nearest i-Beacon info and send to IoT server via LoRaWAN wireless network. IoT Server should have a pre-configure position mapping for beacons in order to trace the location of LBT1 tracker.

LBT1 targets for indoor positioning for people and things.LBT1 has motion detect feature, it will also detect walk steps and uplink the value.

LBT1 is powered by 1000mA rechargeable Li-on battery and charge circuit, which target for real time tracking with short tracking uplink interval.

LBT1 in a LoRaWAN Network

1.2 Specifications

Micro Controller:

- MCU: STM32L072CZT6
- Flash:192KB
- RAM:20KB
- EEPROM: 6KB
- Clock Speed: 32Mhz

Common DC Characteristics:

- Supply Voltage: 5V via USB port or Internal 1000mAh battery
- Operating Temperature: -40 ~ 85°C

LoRa Spec:

- Frequency Range,
  - ✓ Band 1 (HF): 862 ~ 1020 Mhz
- 168 dB maximum link budget.
- High sensitivity: down to -148 dBm.
- Bullet-proof front end: IIP3 = -12.5 dBm.
- Excellent blocking immunity.
- Built-in bit synchronizer for clock recovery.
- Preamble detection.
- 127 dB Dynamic Range RSSI.
- Automatic RF Sense and CAD with ultra-fast AFC.
- LoRaWAN 1.0.3 Specification

Battery:

- 1000mA Li-on Battery power

Power Consumption

- Sleeping Mode: 25uA
- BLE Scanning Mode: 30mA
- LoRa Transmit Mode: 125mA @ 20dBm 44mA @ 14dBm

1.3 Features

- ✓ LoRaWAN 1.0.3 Class A
- ✓ STM32L072CZT6 MCU
- ✓ Frequency bands KR920/US915/IN865/EU868/AS923/AU915
- ✓ Bluetooth iBeacon scanning
- ✓ Walking steps counter
- ✓ Power Monitoring
- ✓ Charging circuit via USB port

- ✓ Tri-color LED, Alarm button

1.4 Applications

- ✓ Logistics and Supply Chain Management
- ✓ Things / Asserts management.
- ✓ Human tracking

1.5 Hardware Change log

LBT1 v1.0:

Release.

2. How to use LBT1?

2.1 Activate LBT1

The LBT1 has three working modes:

- ✓ Deep Sleep Mode-1: LBT1 doesn't have any LoRaWAN activate. This mode is used for shipping to save battery life. User need to use needle to press the side button to activate device.
- ✓ Deep Sleep Mode-0: LBT1 doesn't have any LoRaWAN activate. This mode is used for storage to save battery life. User can double click Alarm button or use needle to press the side button to activate device.
- ✓ Keep Alive Mode: In this mode, LBT1 works as LoRaWAN Sensor to Join LoRaWAN network and send out iBeacon's UUID & ADDR to LoRaWAN server, default interval is 7 minutes. Between each scanning/tx/rx periodically, LBT1 will be in STOP status (IDLE status), in STOP mode, device has the same power consumption as Deep Sleep mode.
- ✓ Walking Mode: In this mode, LBT1 sends the iBeacon's UUID & ADDR to LoRaWAN server in a much shorter interval (10 seconds exclude scanning time).

The LBT1 is set in deep sleep mode by default; the alarm button is used to switch to different modes:

Action on Alarm Button	Function	Result:
Fast press alarm twice	Active Device or Enter into Walking mode	-- If LBT1 is in Deep Sleep Mode-0, it will switch to Keep Alive Mode. Green led will fast blink 5 times, device will be activated and start to join LoRaWAN network. If Joined successfully, green led will turn on solidly for 5 seconds and vibrate. -- If LBT1 is in Keep Alive Mode, it will enter into walking mode.
Pressing alarm for 15 seconds	Exit walking mode	When pressing the alarm button, the green led will be on, after 15 seconds, red led will solid on for 5 seconds. Means LBT1 exit walking mode and enter to Keep Alive Mode

Note: After device is activate, there are two ways to deactivate:

a) Use AT Command (Need USB to TTL Adapter)

b) Or through downlink command (0x0901).

2.2 How it works?

The LBT1 is working as LoRaWAN OTAA Class A end node. Each LBT1 is shipped with a worldwide unique set of OTAA and ABP keys. User needs to input the OTAA or ABP keys in the LoRaWAN network server so to register. LBT1 will join the LoRaWAN network and start to transmit data. The default period for each uplink is 7 minutes (AT+TDC timer).

2.3 Quick guide to connect to LoRaWAN server (OTAA)

Here is an example for how to join the TTN LoRaWAN Server. Below is the network structure, in this demo we use LG308 as LoRaWAN gateway.

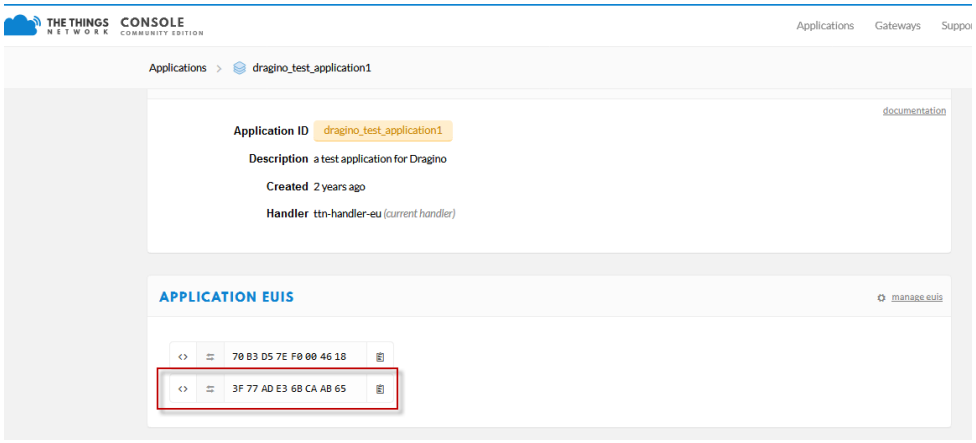
The LG308 is already set to connect to TTN . What the rest we need to is register the LBT1 to TTN:

Step 1: Create a device in TTN with the OTAA keys from LBT1.

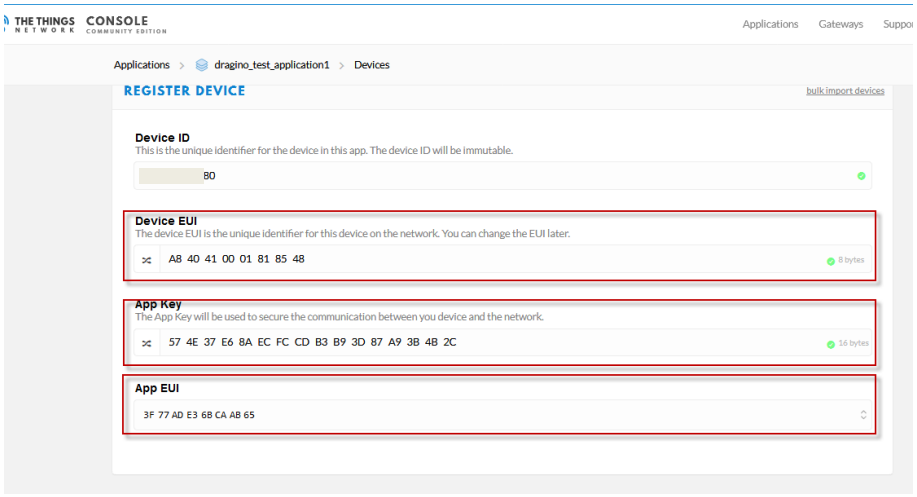
Each LBT1 is shipped with a sticker with the default device EUI as below:

Input these keys in their LoRaWAN Server portal. Below is TTN screen shot:

Add APP EUI in the application

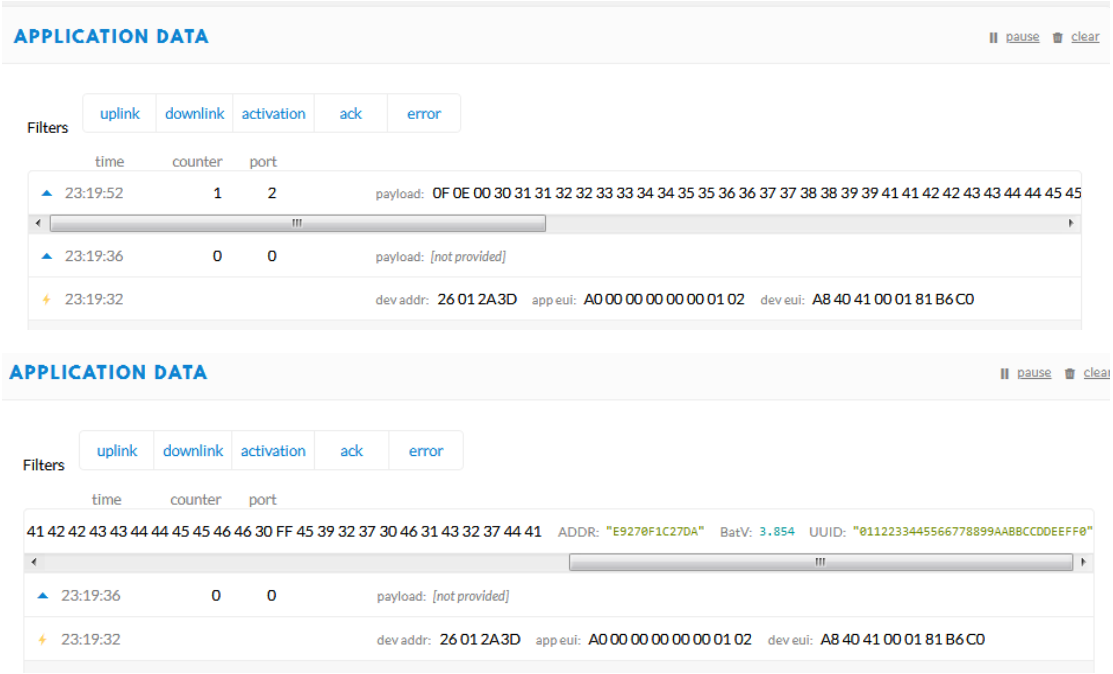


Add APP KEY and DEV EUI



Step 2: Double click alarm button to activate the LBT1

Step 3: LBT1 will auto join to TTN network via the LoRaWAN coverage by LG308. After join success, LBT1 will start to scan nearby valid iBeacon and upload message to IoT server.
If LBT1 can't find a valid iBeacon in three scanning (3 times x 5second/scan), it will fill the uuid and addr with all 0x00 and upload



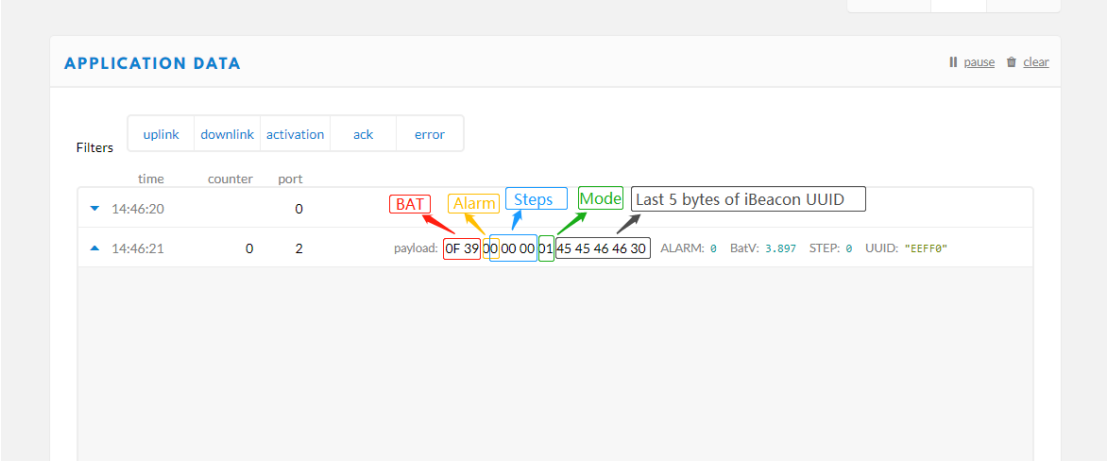
2.4 Uplink Payload

2.4.1 Payload Analyze

Different MODE has different payload:

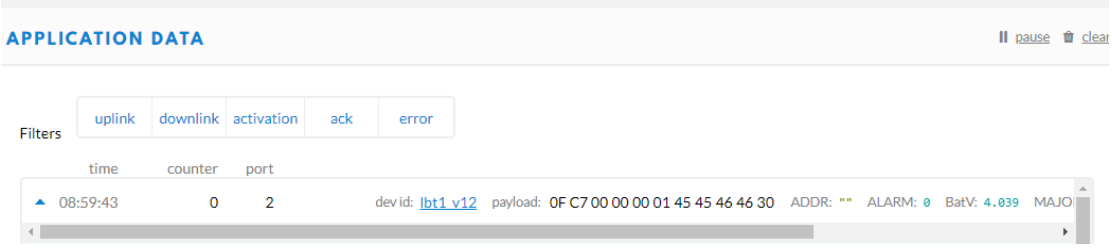
MODE=1

Size(bytes)	2	1	2	1	5
Value	BAT	Alarm + Steps	Steps	0x01 MODE	Last 2.5 bytes of UUID



0FC7000000014545464630

4C000215:01122334455667788 99AABBCCDDEEFF0:01000400C3:E9270F1C27DA



Uplink

Payload

```
0F C7 00 00 00 01 45 45 46 46 30
```

Fields

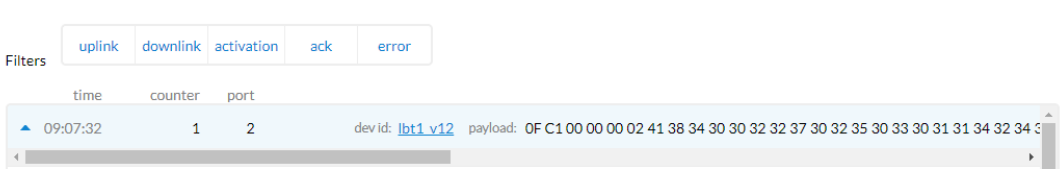

```
{
  "ADDR": "",
  "ALARM": 0,
  "BatV": 4.039,
  "MAJOR": 1,
  "MINOR": 1,
  "RSSI": 0,
  "STEP": 0,
  "UUID": "EEFF0"
}
```


MODE=2

Size(bytes)	2	1	2	1	32	12
Value	BAT	Alarm + Steps	Steps	0x02 MODE	iBeacon UUID	iBeacon ADDR

0FC1000000024138343030323237303235303330313134323430323832303036444545463132454433334432313541453039

4C000215:A84002270250301142402820 06DEEF12:01000400C3:ED33D215AE09



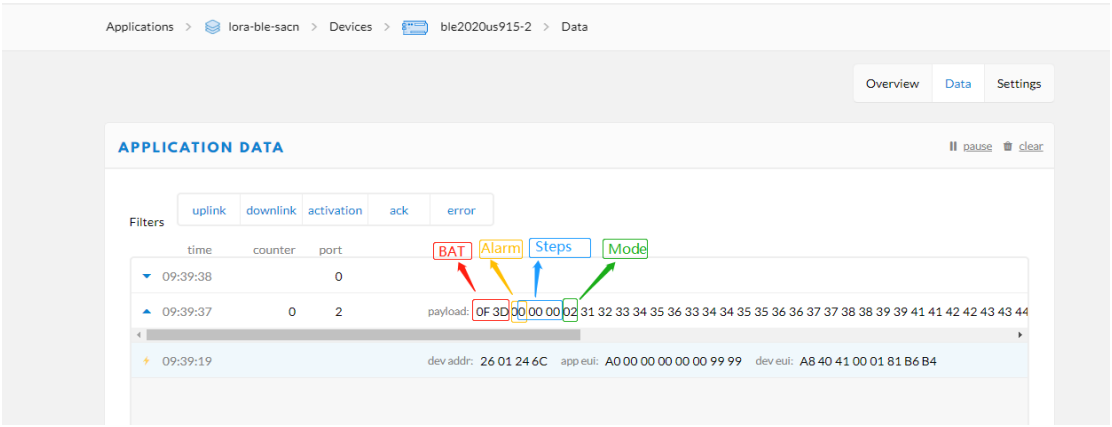
Uplink

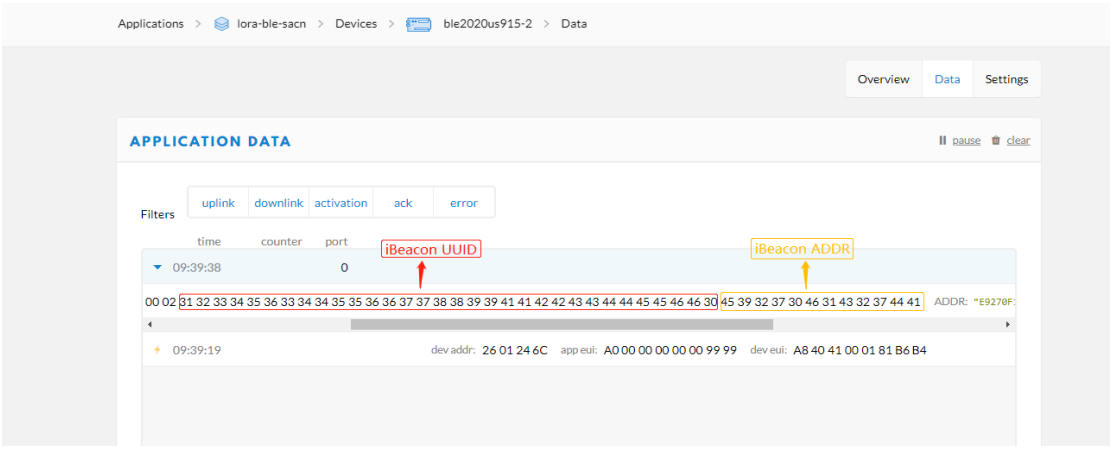
Payload

```
0F C1 00 00 00 02 41 38 34 30 30 32 32 37 30 32 35 30 33 30 31 31 34 32 34 30 32 38 32 30 30 36
```

Fields


```
{
  "ADDR": "ED33D215AE09",
  "ALARM": 0,
  "BatV": 4.033,
  "MAJOR": 1,
  "MINOR": 1,
  "RSSI": 0,
  "STEP": 0,
  "UUID": "A84002270250301142402820 06DEEF12"
}
```

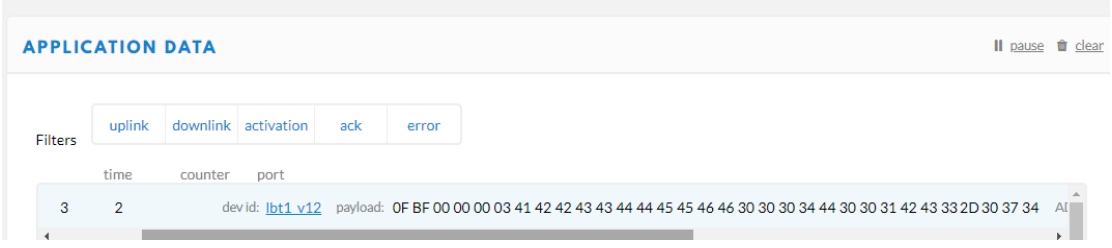


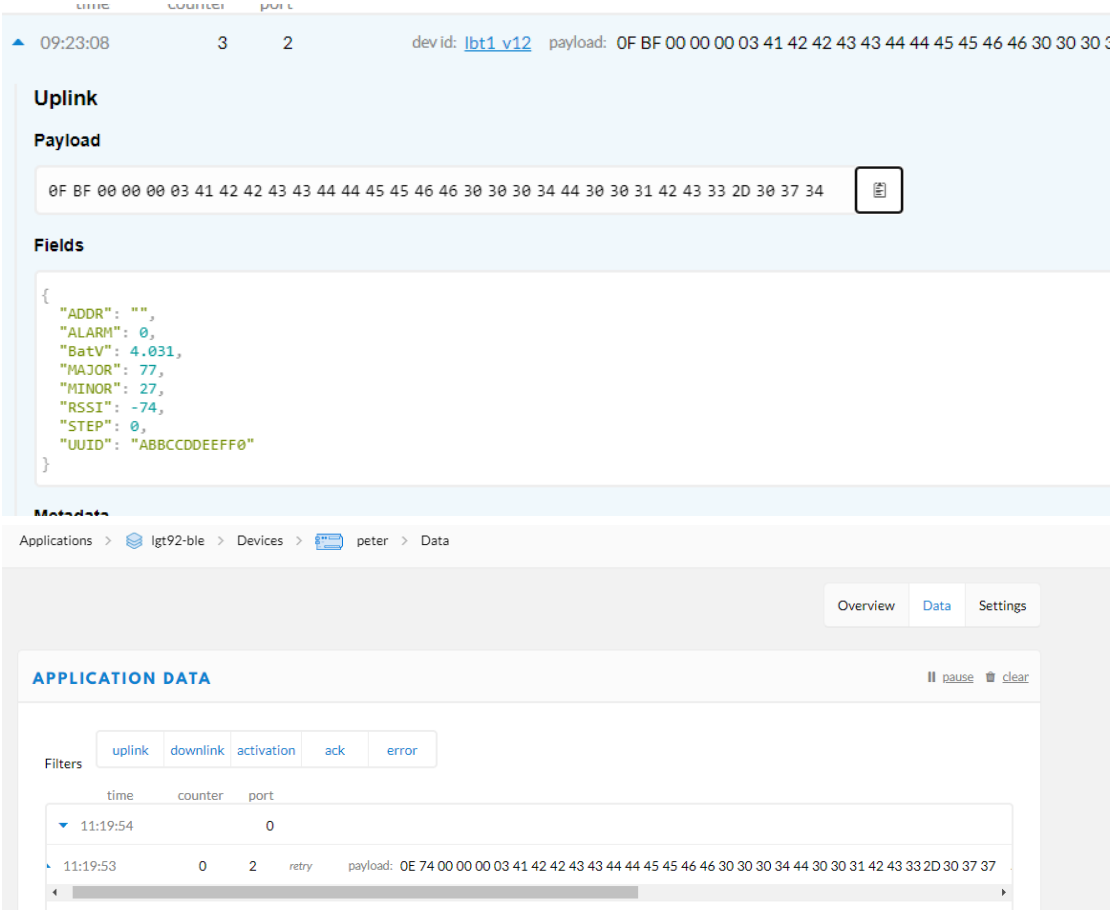


MODE=3

Size(bytes)	2	1	2	1	12	4	4	2	4
Value	BAT	Alarm + Steps	Steps	0x03 MODE	iBeacon UUID	iBeacon MAJOR	iBeacon MINOR	iBeacon Measured Power	iBeacon RSSI

0FBF000000034142424343444445454646303030444303031424333 2D303734
4C000215:01122334455667788 99AABBCCDDEEFF0:004D001BC3:C406AB5DC9D8:-074





✓ **BAT**: Ex1: 0x4B45 & 0x3FFF ⇒ 3901 (mV).

✓ **Alarm**: it is the highest bit of the 3rd byte of the payload, when this bit is 0, it is a normal uplink message, if this bit is 1, it is a uplink message triggered by Alarm.

✓ **Steps:** The 0 ~ 6 bits of 3rd byte and 4th , 5th byte compose the steps. It increases when walk. Range is from
Min: 0b(000 0000 0000 0000 0000 000) = 0
Max: 0b(111 1111 1111 1111 1111 1111) = 0x(7F FF FF) = 8,388,607

✓ **MODE:** Define the payload format.

✓ **UUID:** The uuid from the strongest iBeacon.

✓ **ADDR:** The ADDR from the strongest iBeacon

✓ **MAJOR**: The MAJOR from the strongest iBeacon.
✓ **MINOR**: The MAJOR from the strongest iBeacon.
✓ **Measured Power**: The Measured Power from the strongest iBeacon.
✓ **RSSI**: The RSSI from the strongest iBeacon.

2.4.2 Add Payload format in TTN

In TTN, use can add a custom payload so it shows friendly.

In the page Applications --> Payload Formats --> Custom --> decoder to add the decoder from:

http://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/LBT1_LoRaWAN_BLE_Tracker/Decoder/

2.5 Downlink Payload

LBT1 supports configuration via LoRaWAN downlink command. See this link to check how to use them in different platform:

http://wiki.dragino.com/index.php?title=Main_Page#Use_Note_for_Server

There are two parts of commands for downlink:

2.5.1 General Downlink commands:

These commands are to configure:

- ✓ General system settings like: uplink interval.
- ✓ LoRaWAN protocol & radio related command.

These commands can be found on the downlink command wiki:

http://wiki.dragino.com/index.php?title=End_Device_Downlink_Command

2.5.2 Commands special design for LBT1

These commands are to design for the working LBT1:

Set Payload Mode:

- AT Command:
  AT+MOD=2 // Set Payload MOD =2
  AT+MOD=? // Get current work MOD

- Downlink Payload:
  0xA101 // Same as AT+MOD=1
  0xA102 // Same as AT+MOD=2

Set BLEMASK:

BLEMASK is to filter the unwanted BLE iBeacons during scan. For example, if BLEMASK is 123456. LBT1 will only uplink uuid info which include 123456. It will ignore all other iBeacons which doesn't contact 123456 in the uuid.

Note: BLEMASK range is 6 ~ 10 bytes

- AT Command:
  AT+BLEMASK=123456 // Set BLEMASK = 123456
  AT+BLEMASK=0 // disable BLEMASK
- Downlink Payload: (Prefix : 0xA5)
  Example:

0xA5 010203040506 // Set BLEMASK to 123456

Set AT+SLEEP:

Set device to Deep Sleep Mode, if device is in Deep Sleep Mode, user need to double click the Alarm button to active it.

- AT Command:

  0x0901: AT+SLEEP=1 → Set to Deep Sleep Mode 1.

  0x0900: AT+SLEEP=0 → Set to Deep Sleep Mode 0.

- Downlink Payload: (prefix: 0x09)

  0x0900 // Same as AT+SLEEP=1

  0x0901 // Same as AT+SLEEP=0

2.6 LED Status

See work flow

2.7 Button Function

RESET button:

Press this button will reboot the device. Device will process OTAA Join to network again.

RED alarm button:

See work flow

2.8 USB Port Function

The USB interface of LBT1 has below functions:

- ✓ Power on the device
- ✓ Recharge the LBT1 battery
- ✓ Access UART console of LBT1
- ✓ Upgrade the firmware of LBT1

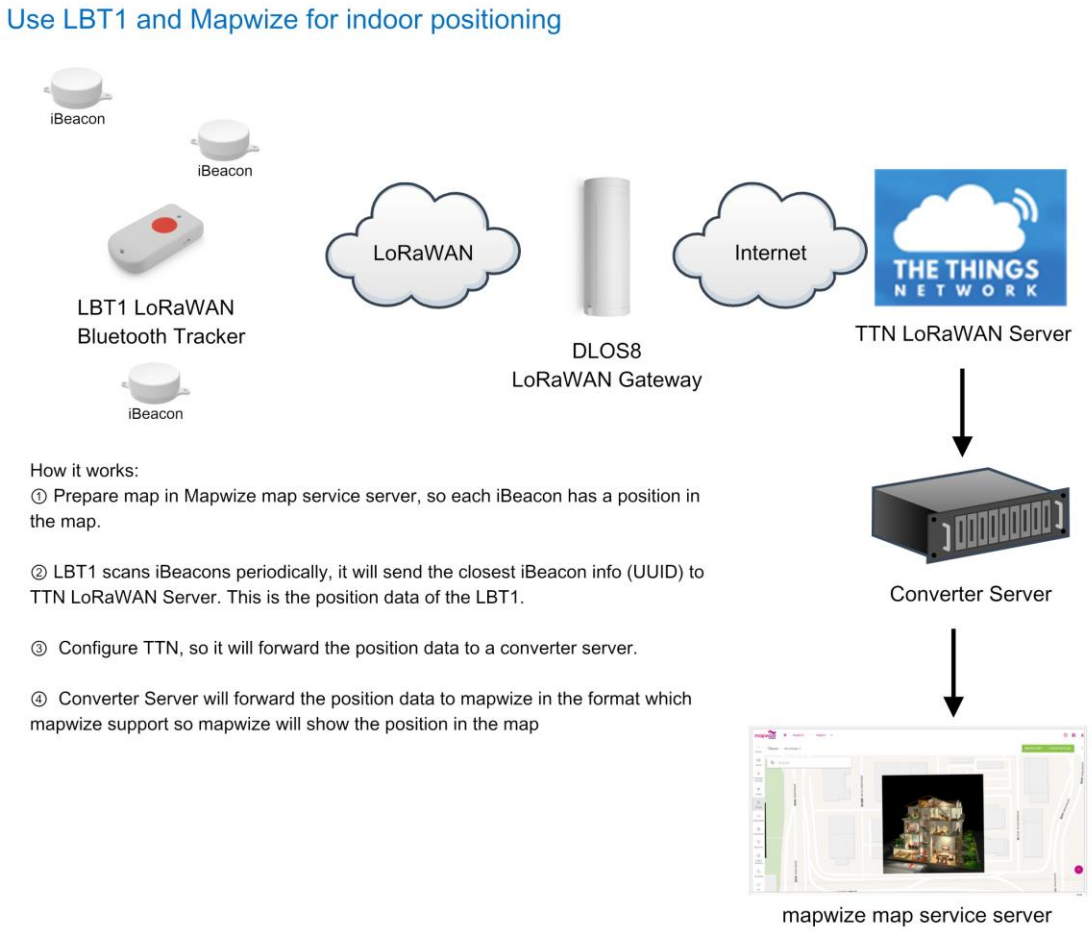
2.9 Firmware Change Log

See this link.

3. Case Study

3.1 User Mapwize service for indoor positioning.

Network Structure:



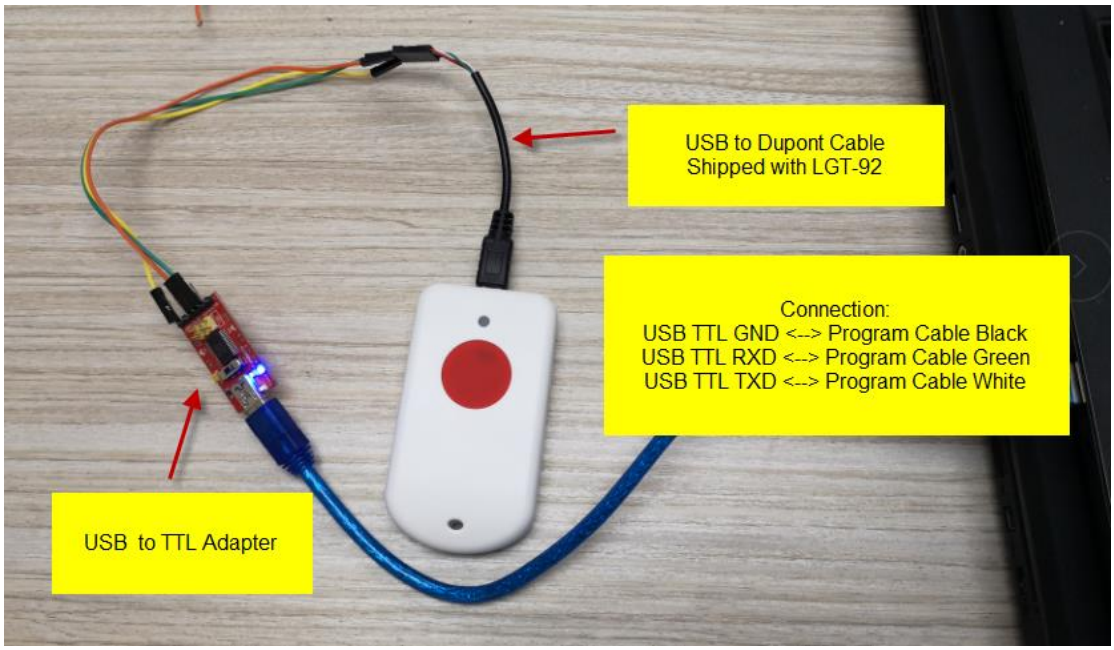
Please check this URL for instruction:

http://wiki.dragino.com/index.php?title=Mapwize

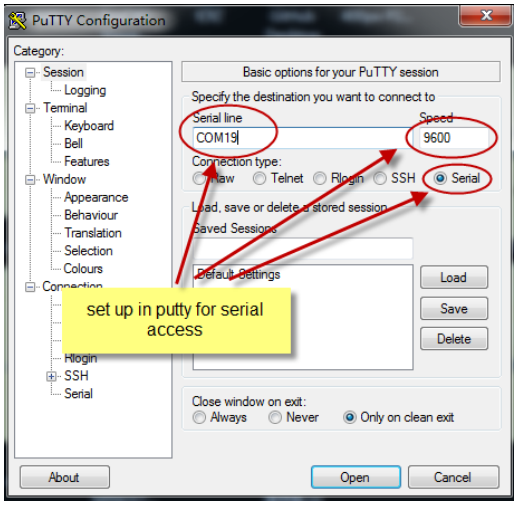
4. Use AT Command

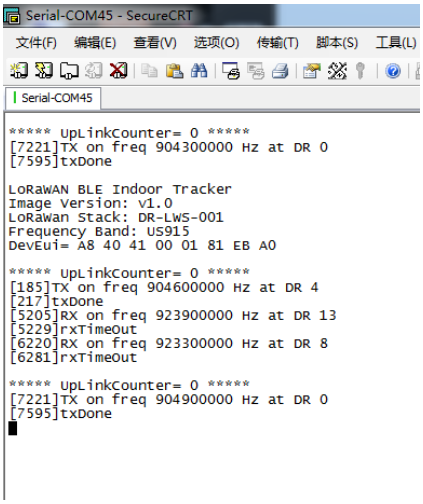
4.1 Access AT Command

LBT1 supports AT Command. User can use a USB to TTL adapter to connect to LBT1 for using AT command, as below.



In PC, User needs to set serial tool baud rate to **9600** to access serial console for LBT1. LBT1 will output system info once power on and user will be able to send AT commands:





Below are the available commands, a more detail AT Command manual can be found at AT Command Manual

AT+<CMD>? : Help on <CMD>
AT+<CMD> : Run <CMD>
AT+<CMD>=<value> : Set the value
AT+<CMD>=? : Get the value

General Command
AT: Attention
AT?: Short Help
ATZ: MCU Reset
AT+TDC: Application Data Transmission Interval

Keys,IDs and EUIs management
AT+APPEUI: Application EUI
AT+APPKEY: Application Key
AT+APPSKEY: Application Session Key
AT+DADDR: Device Address
AT+DEUI: Device EUI
AT+NWKID: Network ID(You can enter this command change only after successful network connection)
AT+NWKSKEY: Network Session Key
Joining and sending date on LoRa? network
AT+CFM: Confirm Mode
AT+CFS: Confirm Status
AT+JOIN: Join LoRa? Network
AT+NJM: LoRa? Network Join Mode
AT+NJS: LoRa? Network Join Status
AT+RECV: Print Last Received Data in Raw Format
AT+RECVB: Print Last Received Data in Binary Format
AT+SEND: Send Text Data
AT+SENB: Send Hexadecimal Data

LoRa network management
AT+ADR: Adaptive Rate
AT+CLASS: LoRa Class(Currently only support class A
AT+DCS: Duty Cycle Setting
AT+DR: Data Rate (Can Only be Modified after ADR=0)
AT+FCD: Frame Counter Downlink
AT+FCU: Frame Counter Uplink
AT+JN1DL: Join Accept Delay1

AT+JN2DL: Join Accept Delay2

AT+PNM: Public Network Mode

AT+RX1DL: Receive Delay1

AT+RX2DL: Receive Delay2

AT+RX2DR: Rx2 Window Data Rate

AT+RX2FQ: Rx2 Window Frequency

AT+TXP: Transmit Power

AT+SLEPP: device is in Deep Sleep Mode

Information

AT+RSSI: RSSI of the Last Received Packet

AT+SNR: SNR of the Last Received Packet

AT+VER: Image Version and Frequency Band

AT+FDR: Factory Data Reset

AT+PORT: Application Port

AT+CHS: Get or Set Frequency (Unit: Hz) for Single Channel Mode

AT+CHE: Get or Set eight channels mode, Only for US915, AU915, CN470

4.2 Common AT Command Sequence

4.2.1 Multi-channel ABP mode (Use with SX1301/LG308)

If device has not joined network via OTAA:

AT+FDR

AT+NJM=0

ATZ

If device already joined network:

AT+NJM=0

ATZ

5. Upload Firmware

User can upload firmware for bug fix or new feature added.

Firmware Location:
http://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/LBT1_LoRaWAN_BLE_Tracker/Image/

Upgrade Instruction:
http://wiki.dragino.com/index.php?title=Firmware_Upgrade_Instruction_for_STM32_base_products#Hardware_Upgrade_Method_Support_List

6. FAQ

6.1 What is the frequency range of LT LoRa part?

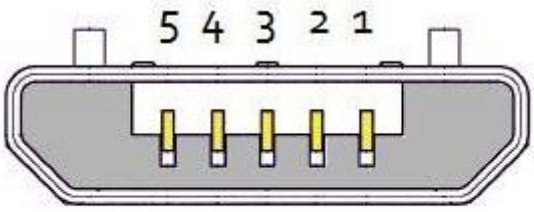
Different LBT1 version supports different frequency range, below is the table for the working frequency and recommend bands for each model:

Version	LoRa IC	Working Frequency	Best Tune Frequency	Recommend Bands
433	SX1278	Band2(LF): 410 ~525 Mhz	433Mhz	CN470/EU433
868	SX1276	Band1(HF):862~1020 Mhz	868Mhz	EU868/IN865/RU864
915	SX1276	Band1(HF):862 ~1020 Mhz	915Mhz	AS923/AU915/ KR920/US915

6.2 How to change the LoRa Frequency Bands/Region?

User can follow the introduction for how to upgrade image. When download the images, choose the required image file for download.

6.3 What is the pin mapping for the USB program cable?



USB Micro-B

Pin	Color	USB Pin	UART pin	ST-Link Pin
1	Red	VCC	N/A	+5V
2	White	D- (N/A)	LGT-RXD	SWDIO
3	Green	D+(N/A)	LGT-TXD	SWCLK
4		ID (N/A)	N/A	
5	Black	GND	GND	GND

7. Trouble Shooting

7.1 Why I can't join TTN in US915 /AU915 bands?

It is about the channels mapping. Please see this link for detail.

7.2 I see AT_ERROR when I type commands?

When you type command, it is possible that the ibeacon scanning conflict with serial input so you see AT_ERROR. Especially in walking mode where this is in a short scanning period.

To overcome this issue, you can:

1) Try to type the command in a txt file and paste it to the console to shorter the input time for command.
2) Try to run AT+FDR first to reset the device to factory default and type.

7.3 Why I am getting Empty payload?

The LBT1 payload if include motion sensor will have 52 bytes, according to the LoRaWAN protocol. The LoRaWAN server will discard this payload on DR0 in AU915/US915 bands. So each packet sent in DR0 will be seen as empty payload

8. Order Info

Part Number: **LBT1-XXX**

XXX: The default frequency band

- ✓ **AS923**: LoRaWAN AS923 band
- ✓ **AU915**: LoRaWAN AU915 band
- ✓ **EU433**: LoRaWAN EU433 band
- ✓ **EU868**: LoRaWAN EU868 band
- ✓ **KR920**: LoRaWAN KR920 band
- ✓ **US915**: LoRaWAN US915 band
- ✓ **IN865**: LoRaWAN IN865 band
- ✓ **CN470**: LoRaWAN CN470 band

9. Packing Info

Package Includes:

- ✓ LBT1 LoRaWAN Bluetooth Tracker x 1
- ✓ USB program cable x 1
- ✓ USB recharge cable x 1
- ✓ Sling x 1

Dimension and weight:

- ✓ Device Size: 85 x 48 x 15 cm
- ✓ Device Weight: 50g

- ✓ Package Size: 10 x 8.5 x 4 cm
- ✓ Package Weight: 111g

10. Support

- ➢ Support is provided Monday to Friday, from 09:00 to 18:00 GMT+8. Due to different timezones we cannot offer live support. However, your questions will be answered as soon as possible in the before-mentioned schedule.
- ➢ Provide as much information as possible regarding your enquiry (product models, accurately describe your problem and steps to replicate it etc) and send a mail to

support@dragino.com

11. Reference

- ✧ Product Page , DataSheet

- ✧ Image Download