# Smart Vehicle Tracker Datasheet

## V1.1

## Release: 2025/10/20

## STATEMENT

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RUICTEC Information Technology Co., LTD

# Catalog

# 1 General Introduction

Tracker is an intelligent hardware based on LoRaWAN transmission. It has built-in motion, Bluetooth, GNSS and other sensors, combined with the external Bluetooth beacon, which can be used not only as a tracking device for indoor and outdoor vehicle positioning, but also as a Bluetooth gateway for asset location management. It can provide vehicle with location services with accuracy from 2 meter to 4 meters inside with the help of BLE beacon and 1 meter to 2 meters outside with the help of GPS. Compared with other schemes, the scheme combining tracker and beacon has the advantages of low cost, convenient deployment, long standby time and so on, and is suitable for the scene with high positioning accuracy.

Function Highlights:

- LoRaWAN 1.0.3 compliant
- Maximum 6-month standby time
- Build-in G-sensor for motion detection
- Online upgrade by BLE, batch upgrading
- Online configure by BLE or Lora
- High capacity battery
- Multi battery optimization setting

# 2 Product Specifications

Table 1: Product Specifications

| Positioning Mode | BLE/GNSS(L1/L5) |
|---|---|
| Protocol | LoRaWAN |
| Frequency | CN470/US915/AU915/AS923/EU868/IN865/KR920/RU864 |
| Sensitivity | -130dBm@SF9, -123dBm@SF8, -115dBm@SF7 |
| Operating Current | 20uA@sleep mode |
| | Max 102mA@20dBm |
| Standby Time | 6 months |
| Operating Temperature | -20~+80℃ |
| Battery | 6000mAh |
| Solar panel | 1.3W 5.5V |
| Charging Temperature | -10~+40℃ |
| Storage Temperature | -40~+85℃ |
| Communication Distance | >1.5km in urban area |

# 3 Application Information

## 3.1 Function

The tracker works in OTAA mode and Class A mode by default, but it can also be set as ABP mode by BLE configure. In both modes, DevEUI, AppEUI and AppKey, or DevAddr, NwkSkey and AppSkey, frequency can be changed.

The tracker supports both BLE and GNSS location. To support BLE location, the BLE beacons need to be deployed around the tracker, the tracker gets its position by detecting the BLE signal.

If no beacon signal is scanned, the tracker will turn on GNSS module to get satellite signal, vice versa, if beacon signal is scanned, GNSS main power will be turned off with backup power on. BLE function is disabled by default. According to LoRaWAN specification, in Class A mode downlink response time is decided by uplink duty cycle. To avoid relying the position message for downlink configure, tracker uses heartbeat message to control the downlink response time. The default heartbeat period is 30 minutes. Heartbeat message also contains status information of the tracker. It can be used by customer server to monitor the tracker.

## 3.2 Operation

### 3.2.1 Power On/Off

There's no button on the tracker, plug in the power cable can start up the device. The buzzer beeps, it shows the tracker start up.

### 3.2.2 Reboot

1. Plug in the power cable.
2. Send reboot command from customer server remotely.

### 3.2.3 Charging

When the power is low, it should be charged in time. The charging interface is 5V/1A input. When the power is not fully charged, the red LED keeps on, and the green LED keeps on when the power is fully charged.

With 5V/1A input, the maximum charging current is 930mA.
With Solar panel input, the maximum charging current is 230mA.
The main power consumption component is GPS L1/L5 module and active antenna, the power is about 65mA.

## 3.3 Uplink Messages

| Message Type | CAS ACK Need | LNS ACK Need | Port |
|---|---|---|---|
| Heartbeat | No | Yes | 10 |
| GNSS coordinate | No | Yes | 11 |
| BLE coordinate | No | Configurable | 12 |
| Alarm | No | Yes | 13 |
| Acknowledge | No | Yes | 14 |
| Locator Beacon UUID | No | Yes | 15 |
| History GNSS Info List | No | Yes | 20 |

LNS ACK Need means LoRaWAN Network Server need to confirm the uplink message, else the device will retry for one time.
CAS ACK Need means Customer Application Server need to confirm the uplink message, else the device will retry till confirmed.
Port is the frame port of LoRa message, used for message recognization before the payload is parsed.

# 3.3.1 Heartbeat

Heartbeat is a message periodically sent to report device parameters and operating status regardless of device movement status. When the device is stationary, the application server can send downlink parameters or commands when receiving heartbeat messages.

| Bytes | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 1 | 2 | 1 |
|-------|-----|------|-----|--------|-----|-----|-----|-----|-----|--------|-------|------|-------|------|------|
| Item | VER | RSSI | SNR | STATUS | VOL | COM | BLE | RFU | GPS | PERIOD | SLEEP | TIME | THRES | RFU | TEMP |

ACK from LNS needed, else will resend for one time.

**VER:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~6 | HW | 0~3 | Hardware type. <br> 0: Badge <br> 1: BLE Gateway <br> **2: Vehicle Tracker** <br> 3: Reserved |
| 5~4 | Major | 0~3 | Major version of software, 0 for test |
| 3~0 | Minor | 0~15 | Minor version of software |

**RSSI:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~0 | RSSI | -128~127 | The downlink Received Signal Strength Indication, sent by the LoRa gateway, detected and calculated by the device. <br> Unit: dBm <br> The real value is (RSSI - 20). <br> For example, if the reported RSSI is -110, the final value should be -130dBm. |

**SNR:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~0 | SNR | -128~127 | The downlink Signal Noise Ratio. |

**STATUS:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~5 | GNSS | 0x0: off <br> 0x1: Positioning <br> 0x2: Positioning success <br> 0x3: no signal <br> 0x4: Indoor <br> 0x5: Stationary | Status of GNSS module. <br> 0: GNSS function is disabled because of continuous positioning failure or located in BLE environment. <br> 1: GNSS module is searching the signal. <br> 2: GNSS module succeed to acquire the coordinates. <br> 3: Fail to acquire the coordinates. <br> 4: GNSS is off because detect the device is indoor. <br> 5: GNSS is off because detect the device is stationary for at least two minutes. <br> The GNSS module will try to acquire the coordinates in |

| Bit | Name | Value | Description |
|---|---|---|---|
| | | | 60 seconds, if fail it will stop searching. Only apply for badge and T-Box. |
| 4~3 | BATTERY | 0x0: power cable disconnected 0x1: power cable connected, charging 0x2: power cable connected, charge completed | Status of battery charging. Only apply for badge. |
| 2 | VIBSTATE | 0: Stationary 1: Nonstationary | Motion status. Indicates whether the device moved during the heartbeat period. Only apply for badge and T-Box. |
| 1 | Work Mode | 0: Tracker 1: Gateway | 0 indicates the device works as a tracker. 1 indicates the device works as a BLE gateway. Only apply for badge. |
| 0 | RFU | 0 | Reserved for future use. |

**Voltage:**

| Bit | Name | Value | Description |
|---|---|---|---|
| 7~0 | VOL | 0~255 | Real battery voltage = VOL/100 + 2(V) Only apply for badge and T-Box. |

**Communication parameters:**

| Bit | Name | Value | Description |
|---|---|---|---|
| 7~6 | TXPOW | 0x0~0x3 | Configured transmit power. For EU868 and AS923: 0x0: 16dBm 0x1: 14dBm 0x2: 12dBm 0x3: 10dBm For US915 and AU915: 0x0: 20dBm 0x1: 18dBm 0x2: 16dBm 0x3: 14dBm For CN470： 0x0: 17dBm 0x1: 15dBm 0x2: 13dBm 0x3: 11dBm Default value is 0. |
| 5~3 | DR | 0x0~0x3 | Supported Data Rate. US915: 0x0: DR3 |

| | | | 0x1: DR2 |
|---|---|---|---|
| | | | 0x2: DR1 |
| | | | AS923, AU915, EU868, CN470,IN865,KR920,RU864: |
| | | | 0x0: DR5 |
| | | | 0x1: DR4 |
| | | | 0x2: DR3 |
| | | | Default value is DR3 for US915, DR5 for others. |
| | | | ADR feature is disabled, the customer need to configure proper DR according to the maximum distance between device and gateway. |
| 2~0 | SCHEME | 0x0~0x07 | Working scheme |
| | | | 0x0: US915 |
| | | | 0x1: EU868 |
| | | | 0x2: AU915 |
| | | | 0x3: CN470 |
| | | | 0x4: AS923 |
| | | | 0x5: KR920 |
| | | | 0x6: IN865 |
| | | | 0x7: RU864 |

**BLE:**

| Bit | Name | Value | Description |
|---|---|---|---|
| 7 | AUREPORT | 0: Disable<br>1: Enable | Indicates whether the tracker start BLE scan and report coordinates even it's stationary, it is mainly used during test.<br>The default value is 0, in this case the tracker only turns on Bluetooth scanning and GNSS when it detects movement. |
| 6~3 | BLE | 0: BLE disabled<br>1: 5sec<br>2: 10sec<br>3: 20sec<br>4: 30sec<br>5: 1min<br>6: 2min<br>7: 5min<br>8: 10min<br>9: 15min<br>10: 20min<br>11: 30min<br>12: 1h<br>13: 2h<br>14: 6h<br>15: 12h | BLE scan cycle.<br>The default value is 0 seconds. |
| 2~0 | SCAN | 0: 1s<br>1: 2s<br>2: 3s | Duration of Bluetooth scanning in one cycle.<br>This value is determined by the Bluetooth beacon transmission cycle, if the beacon broadcast every 500ms, 1s is proper. |

| | | 3: 6s<br>4: 9s<br>5: 12s<br>6: 15s<br>7: Always | In some cases, to save the power of beacon, may extend the interval of beacon to 1 second, then SCAN need to be changed to 2 seconds to ensure beacon can always be scanned.<br><br>The default value is 1s.<br>This value should be set less than **BLE** value mentioned above, if it's larger than BLE, it will be changed to BLE-1 by the device. |
|---|---|---|---|

The following figure shows the relationship between BLE and SCAN parameters if AUREPORT is enabled.
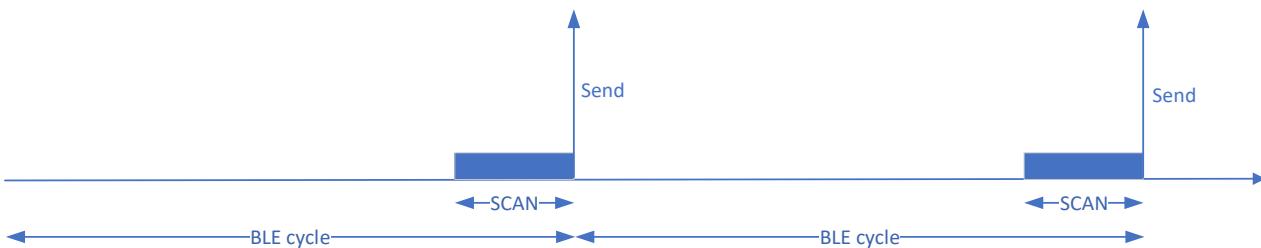


The following figure shows the relationship between BLE and SCAN parameters if AUREPORT is disabled.
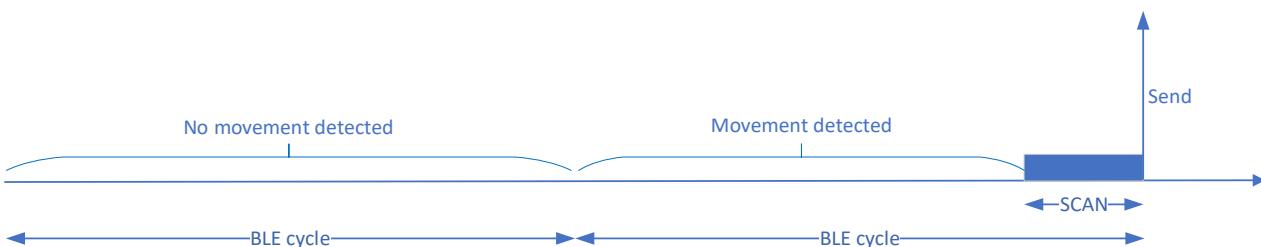


The above strategy is also applicable to GPS.

**RFU:**

| Bit | Name | Value | Description |
|---|---|---|---|
| 7~0 | RFU | 0 | Reserved for future use |

**GPS:**

| Bit | Name | Value | Description |
|---|---|---|---|
| **7~4** | RFU | | |
| **3~1** | Time | 0~7 | Each time the positioning starts, the GPS module takes approximately 10 seconds to obtain the latitude and longitude information. At the beginning, the obtained position information has a large deviation. It is necessary to obtain the position data after the position stabilizes. For each positioning cycle, the duration for continuously obtaining stable positioning information can be configured. The longer the positioning time, the higher the accuracy. A balance needs to be sought between accuracy and power.<br>Starting from the moment the first position data was obtained from the GPS: |

| | | | |
|---|---|---|---|
| | | | If GPS location period is 30s, the GPS will last for<br>      5 + Time seconds;//5~12s<br>else if GPS location period is 60s, the GPS will last for<br>      5 + Time *2 seconds; //5~19s<br>else if GPS location period is 150/300s, the GPS will last for<br>      5 + Time*3 seconds; // 5~26s<br>else if GPS location period is 15m, the GPS will last for<br>      5 + Time*5 seconds; // 5~40s<br>else<br>      5 + Time * 10 seconds; //5~75s |
| **0** | RFU | 0 | |

**PERIOD**:

| Bit | Name | Value | Description |
|---|---|---|---|
| 7~4 | GNSS | 0: GPS disabled<br>1: 5s<br>2: 10s<br>3: 15s<br>4: 30s<br>5: 60s<br>6: 150s<br>7: 5min<br>8: 15min<br>9: 30min<br>10: 1h<br>11: 1.5h<br>12: 3h<br>13: 6h | GNSS startup cycle.<br>The default value is 60s. |
| 3~0 | HB | 0: 1min<br>1: 5min<br>2: 10min<br>3: 20min<br>4: 30min<br>5: 1h<br>6: 2h<br>7: 6h<br>8: 12h<br>9: 24h | Heartbeat transmission period.<br>The default value is 30 minutes. |

**SLEEP:**

In some scenarios, the device does not need to work 24 hours a day. To save power, you can set the device to sleep when it is not working. During the sleep, the device does not send data or the data sending frequency is reduced.

| Bit | Name | Value | Description |
|---|---|---|---|
| 15~13 | RFU | 0 | Reserved for Future Use. |

| 12~10 | Degree | 0~7 | Between Start and End time, the period will be Degree * BLE or HB, 0 means no message reported. To save power, during special time the badge can stop working or slow down the message frequency. It's controlled by Degree, Start and End. Default value is 0. |
|---|---|---|---|
| 9~5 | Start | 0~23 | From this hour, the device will enter sleep mode. Local time. Default value is 0. |
| 4~0 | End | 0~23 | From this hour, the device will wake up from sleep mode. If Start equals to End, the device will not enter sleep mode. local time. Default value is 0. |

**TIME:**

| Bit | Name | Value | Description |
|---|---|---|---|
| 31~0 | Time | | Seconds since 1970/01/01 00:00:00 The device needs to know the exact time if sleep mode is enabled. The device cannot obtain the time based on the GNSS because the GNSS function may not be enabled. In this case, the device periodically reports the device time. If the server detects a large time error, the server send a command to adjust the device time. Suggest to adjust the time when the time error exceeds 10 seconds. If Start equals to End, TIME will not be reported. |

**THRES**:

| Bit | Name | Value | Description |
|---|---|---|---|
| 7~4 | RFU | 0 | Reserved for future use. |
| 3 | BLEACK | 0: Disable<br>1: Enable | Indicates whether BLE message need acknowledged by LNS. By default, Bluetooth messages do not need to be acknowledged. Therefore, there is a probability of lost messages. In some applications, Bluetooth messages may be too important to be lost, so you can set this parameter to obtain the server's confirmation. |
| 2~0 | BLE Scan Range | 0: No limit<br>1:-90dbm<br>2:-87dbm<br>3:-84dbm<br>4:-81dbm<br>5:-78dbm<br>6:-75dbm<br>7:-72dbm | If the RSSI of detected beacon is less than this value, it will be ignored. When the beacon is positioned at the edge of the building, it can be scanned by the tracker outside the building, and the tracker can be mistaken for being inside. This parameter enables the device to ignore weak Bluetooth signals, reducing miscalculation. |

**RFU:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 15~0 | RFU | 0~ 65535 | Reserved for future use |

TEMP:

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~0 | TEMP | 0~ 255 | Indicates the current ambient temperature. 50 needs to be subtracted from the reported value to get the actual temperature. For example, if the reported value is 40, the actual temperature is -10 degrees. |

# 3.3.2 GNSS coordinate

| Bytes | 4 | 4 | 4 | 1 |
|-------|---|---|---|---|
| Item | LONGITUDE | LATITUDE | ALTITUDE | TIME |

**LONGITUDE:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 31 | ORIENTATION | 0~1 | 0: East longitude<br>1: West longitude |
| 30~0 | LONGITUDE | 0~1,800,000,000 | Longitude, formula is: (LONGITUDE / 10^7) + (LONGITUDE % 10^7) / (100000.0 * 60). |

**LATITUDE:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 31 | ORIENTATION | 0~1 | 0: North latitude<br>1: South latitude |
| 30~0 | LATITUDE | 0~ 900,000,000 | Latitude, formula is: (LATITUDE / 10^7) + (LATITUDE % 10^7) / (100000.0 * 60). |

**LATITUDE:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 31~0 | ALTITUDE | 0~ 2,147,483,647 | Altitude / 100 to get the real value. |

**TIME:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~0 | TIME | 0~60 | The time it takes to locate a GNSS location.<br>If the badge fail to acquire coordinate in 60 seconds, it will stop acquiring coordinate and try again in next cycle.<br>Unit: Second |

## 3.3.3 BLE Coordinates

This message is used to report the locator beacon, asset beacon, or adjacent badge detected by the device. For locator beacons, only four of the strongest signals are reported.

| Bytes | 1 | 1 | 1 | | 2 | 2 | 1 | 1 | 2 | 1 | .. | 2 |
|-------|-----|-------|-------|-----|--------|---------|--------|------|---------|--------|-----|--------|
| Item | TYPES | M1NUM | M2NUM | … | MAJOR1 | MINOR11 | RSSI11 | BAT | MINOR12 | RSSI12 | .. | MAJOR2 |

In most beacon deployment schemes, Bluetooth beacons have the same Major, and it would be wasteful to send both Major and Minor for each beacon, so multiple beacons can send only one Major.

**TYPES:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~5 | RFU | 0 | Reserved for future use. |
| 4 | Close Contact | 0~1 | Indicates whether the badge is too close to others. |
| 3~0 | TYPES | 1~15 | The Major types of scanned beacons in this message. It indicates how many different Majors reported in one message. |

**M1NUM:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~6 | RFU | 0 | Reserved for future use. |
| 5~0 | LENGTH | 1~63 | The number of beacons with the same Major as Major1. In the same way, M2NUM means the number of Major as Major2. |

**MAJOR1:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 15~0 | MAJOR1 | 0~65535 | Major of BLE beacon. |

**MINOR11:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 15~0 | MINOR11 | 0~65535 | Minor of BLE beacon which Major is MAJOR1. |

MINOR11 and MINOR12 are the beacons which have the same MAJOR as MAJOR1.

**RSSI11:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7 | BATIND | 0~1 | Indicates whether battery information is added after RSSI field.<br>0: No battery info<br>When BEACON is 3, BATIND has a special function. If BEACON is 3 and BATIND is 1, it indicates the scanned beacons are used for lost people and pets, this information is helpful for searching lost people/pets purpose.<br>The BLE UUID for people/pets must be:<br>806429D8CD7240DB80362A8D6917DA5E |
| 6~5 | BEACON | 0~3 | 0: Beacon used for positioning.<br>1: Beacon used for asset management. |

| | | | 2: Beacon deployed in hazardous area for security. |
| | | | 3: Badge used for proximity detection. |
| 4~0 | RSSI11 | 0~31 | Received Signal Strength Indication of BLE, the server utilize it to calculate the distance. |
| | | | The real value is (RSSI11 + 59) * (-1) dbm. |
| | | | If the RSSI calculated by the badge is smaller than -90dbm, it will always report 31. |
| | | | If the RSSI calculated by the badge is larger than -59dbm, it will always report 0. |

If alarm beacon is scanned, the buzzer will beep for three times.


**BAT:**

| Bit | Name | Value | Description |
|---|---|---|---|
| 7 | RFU | 0 | Reserved For Future Use. |
| 6~0 | BAT | 0~100 | The remaining power, unit: Percent. |
| | | | If the battery detection is not supported by the beacon, it will be set as 0. For the beacons produced by RCT, RSSI@1m field of iBeacon message is used for battery indication. |
| | | | It's only supported by RCT produced beacon. |

Here is an example how the scanned beacons are organized in this message. Suppose there're three kinds of beacons, steps is 50.

Major: 0x0101 Minor: 0x1101 RSSI:-60dbm BAT: 90% Type: Asset

Major: 0x0101 Minor: 0x1102 RSSI:-65dbm BAT: Unknown Type: Locator

Major: 0x0101 Minor: 0x1103 RSSI:-70dbm BAT: 80% Type: Alarm

Major: 0x0201 Minor: 0x2101 RSSI:-59dbm BAT: 80% Type: Proximity

Major: 0x0201 Minor: 0x2102 RSSI:-60dbm BAT: 90% Type: Proximity

Major: 0x0101 Minor: 0x3101 RSSI:-75dbm BAT: 90% Type: Locator

Major: 0x0101 Minor: 0x3102 RSSI:-80dbm BAT: 80% Type: Asset

Major: 0x0301 Minor: 0x3101 RSSI:-65dbm BAT: Unknown Type: Asset

Major: 0x0301 Minor: 0x4102 RSSI:-60dbm BAT: 90% Type: Proximity

Major: 0x0401 Minor: 0x5101 RSSI:-60dbm BAT: 90% Type: Alarm

Major: 0x0401 Minor: 0x5102 RSSI:-65dbm BAT: 80% Type: Locator

Major: 0x0401 Minor: 0x5103 RSSI:-75dbm BAT: 90% Type: Asset


The message should be: 0x000032 04 05020203 0101 11018A15A 110206 1103CB50 3101905A 3102B550 0201 2101D050 2102D15A 0301 310126 4102D15A 0401 5101C15A 51028650 5103B05A


# 3.3.4 Alarm

| Bytes | 1 | 1 | |
|---|---|---|---|

| Item | MSGID | ALARM |
|------|-------|-------|

ACK from LNS needed, else will resend for one time.

**ALARM:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~5 | RFU | 0 | Reserved for future use. |
| 4 | ACK | 0-1 | 0: ACK from the customer server not needed. 1: ACK from the customer server needed, else will resend till ACK received. |
| 3~0 | ALARM | 2:Power off 5:GPS disabled 7: GPS invalid | Alarm type. 2 Tracker is powered off. Tracker can't be powered off by the button. Power off is triggered by remote command or BLE command. 5 GPS function disabled because of continuous weak GPS signal. 7 GPS accuracy is poor and results are ignored. |

**MSGID:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~0 | MSGID | 0~255 | Tracker generated sequence number of this uplink message that need MSGID, CS should respond ACK with this number, and otherwise tracker will resend the message. |

# 3.3.5 Acknowledge

| Bytes | 1 | 1 |
|-------|---|---|
| Item | MSGID | RESULT |

Confirmation of a downlink message indicates that the downlink message has been received.

**MSGID:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~0 | MSGID | 0~255 | The MSGID field of corresponding downlink message. |

**RESULT:**

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~4 | RFU | 0 | Reserved for Future Use. |
| 3~0 | RESULT | | 0: Downlink message received and handle correctly. 1: Parameter not supported to set. 2: Parameter out of range. |

## 3.3.6 Locator beacon UUID

Locator beacon can be scanned by both badge and T-Box. For tracker it only report at most three locator beacons of strongest signal.

By default, the tracker can parse standard beacon in iBeacon format and the UUID must be EFE49FA5F2BF48FF89F1AFCD8A7B5E81. If the customers have other kinds of standard iBeacon, but the UUID is different, the customer can configure this UUID in the tracker. The maximum supported UUID number is five, this message is used to report the configured UUID list.

This message must be requested by the server, else the tracker will not report.

Port: 15

| Bytes | 1 | 1 | 16 | |
|---|---|---|---|---|
| Item | NUMBER | INDEX | UUID | … |

NUMBER field

| Bit | Name | Value | Description |
|---|---|---|---|
| 7~3 | RFU | 0 | Reserved for Future Use. |
| 2~0 | NUMBER | 0~5 | The number of configured UUID. Currently the maximum supported UUID is five. |

INDEX field

| Bit | Name | Value | Description |
|---|---|---|---|
| 7~3 | RFU | 0 | Reserved for Future Use. |
| 2~0 | INDEX | 0~4 | The index of the UUID in the list. |

UUID field

| Bit | Name | Value | Description |
|---|---|---|---|
| 127~0 | UUID | | UUID. |

## 3.3.7 History GNSS Info List

Port: 20

| Bytes | 1 | 4 | 4 | 2 | 2 | |
|---|---|---|---|---|---|---|
| Item | NUMBER | LONGITUDE | LATITUDE | FRMOFF | TIMEOFF | … |

NUMBER field

| Bit | Name | Value | Description |
|---|---|---|---|
| 7~4 | RFU | 0 | Reserved for Future Use. |
| 3~0 | NUMBER | 1~8 | The number of GNSS position. Currently the maximum supported number is 8. |

FRMOFF field

| Bit | Name | Value | Description |
|---|---|---|---|
| 15~0 | FRMOFF | 0~65535 | The delta between the lost frame and the frame of current message. |

TIMEOFF field

| Bit | Name | Value | Description |
|---|---|---|---|
| 15~0 | TIMEOFF | 0~65535 | The delta with the frame of current message.<br>Unit: Second |

# 3.4 Downlink Messages

All downlink messages need to be confirmed by the device.

| Message Type | Frame Port |
|---|---|
| Parameter Setting | 10 |
| Command | 12 |
| Acknowledge | 13 |
| Locator beacon UUID | 14 |

## 3.4.1 Parameter Setting

Port: 10

| Bytes | 1 | 1 | 1 | 1 | |
|---|---|---|---|---|---|
| Item | MSGID | TYPE | VALUE | TYPE | … |

TYPE is from 1 to 17.

Example: For CN470, to set TXPOWER as 15, Data rate as DR4, the message could be: 0x0001010201

All the supported TYPEs are listed as below:

## TX Power

Type: 1

| Bit | Name | Value | Description |
|---|---|---|---|
| 7~0 | TXPOW | 0x0~0x3 | Configure transmit power.<br>For EU868 and AS923:<br>0x0: 16dBm<br>0x1: 14dBm<br>0x2: 12dBm<br>0x3: 10dBm<br>For US915 and AU915:<br>0x0: 20dBm |

| | | | 0x1: 18dBm |
|---|---|---|---|
| | | | 0x2: 16dBm |
| | | | 0x3: 14dBm |
| | | | For CN470： |
| | | | 0x0: 17dBm |
| | | | 0x1: 15dBm |
| | | | 0x2: 13dBm |
| | | | 0x3: 11dBm |
| | | | Other values will be ignored, and respond out of range. |

## Data Rate

Type: 2

| Bit | Name | Value | Description |
|---|---|---|---|
| 7~0 | DR | 0x0~0x2 | Data Rate. US915: 0x0: DR3 0x1: DR2 0x2: DR1 AS923, AU915, EU868, CN470: 0x0: DR5 0x1: DR4 0x2: DR3 For US915 DR1 should only be set when there are only a few beacons. |

## AUREPORT

Type: 3

| Bit0 | AUREPORT | 0: Disable 1: Enable | Indicates whether the badge report coordinates if it's static. It is mainly used for test. |
|---|---|---|---|

## BLE

Type: 4

| 7~0 | BLE | 0: Disable BLE 1: 5sec 2: 10sec | Change the period of BLE scanning. Other values will be ignored and respond out of range. |
|---|---|---|---|

| | | 3: 20sec<br>4: 30sec<br>5: 1min<br>6: 2min<br>7: 5min<br>8: 10min<br>9: 15min<br>10: 20min<br>11: 30min<br>12: 1h<br>13: 2h<br>14: 6h<br>15: 12h | |
|---|---|---|---|

## SCAN

Type: 5

| 7~0 | SCAN | 0: 1s<br>1: 2s<br>2: 3s<br>3: 6s<br>4: 9s<br>5: 12s<br>6: 15s<br>7: Always | The continuous BLE scan time during one period.<br>Other values will be ignored and respond out of range.<br><br>If the device is gateway and powered by an external power, then SCAN can be set as 7. |
|---|---|---|---|

## GPS Time

Type: 11

| 7~0 | Time | 0~7 | |
|---|---|---|---|

## GNSS

Type: 13

| 7~0 | GPS | 0: Disable GPS<br>1: 5s<br>2: 10s<br>3: 15s<br>4: 30s | The period of GPS coordinates report. |
|---|---|---|---|

| | | 5: 60s | |
|---|---|---|---|
| | | 6: 150s | |
| | | 7: 5min | |
| | | 8: 15min | |
| | | 9: 30min | |
| | | 10: 1h | |
| | | 11: 1.5h | |
| | | 12: 3h | |
| | | 13: 6h | |

# HB

Type: 14

| 7~0 | HB | 0: 1min | The period of Heartbeat message. |
|---|---|---|---|
| | | 1: 5min | |
| | | 2: 10min | |
| | | 3: 20min | |
| | | 4: 30min | |
| | | 5: 1h | |
| | | 6: 2h | |
| | | 7: 6h | |
| | | 8: 12h | |
| | | 9: 24h | |

# SLEEP

Type: 16

| 23~16 | Degree | 0~7 | |
|---|---|---|---|
| 15~8 | Start | 0~23 | |
| 7~0 | End | 0~23 | |

When a device boot up, it shouldn't enter sleep mode at once even the Start and End are configured, the parameters only take effect 10 minutes later after boot up. This strategy gives the server the chance to recover the device from sleep mode to active mode by rebooting the device and sending new configuration.

# THRES

Type: 17

| Bit | Name | Value | Description |
|---|---|---|---|

| 7~3 | RFU | 0 | Reserved for future use. |
|---|---|---|---|
| 2~0 | BLE Scan Range | 0: No limit<br>1:-90dbm<br>2:-87dbm<br>3:-84dbm<br>4:-81dbm<br>5:-78dbm<br>6:-75dbm<br>7:-72dbm | If the RSSI of detected beacon is less than this value, it will be ignored. |

# 3.4.3 Command

Port: 12

| Bytes | 1 | 1 |
|---|---|---|
| Item | MSGID | CMD |

The tracker will send ACK to the Application server with the same MSGID. The Application server should maintain a timer to resend, the timer interval should be set according to the period of the uplink messages. The downlink message is able to be sent to the badge after several uplink messages received, if no ACK received from badge after that, the downlink message may be lost.

CMD field

| Bit | Name | Value | Description |
|---|---|---|---|
| 7~4 | RFU | 0 | Message type, helmet can use it to identify different downlink messages. |
| 3~0 | CMD | 0x0: Position request<br>0x1: Reset<br>0x2: Turn off<br>0x3: Search<br>0x4: Dismiss Search<br>0x5: Locator beacon list<br>0x9: Time synchronization | Requested command.<br>0x0: Request the tracker to send the position even the device is static.<br>0x1: Reset the device.<br>0x2: Turn off the device.<br>0x3: Trigger buzzer beep.<br>0x4: Stop buzzer beep.<br>0x5: Acquire the supported locator beacon UUID which are in iBeacon format.<br>0x9: Trigger the device to synchronize time with NS. |

MSGID field

| Bit | Name | Value | Description |
|---|---|---|---|
| 7~0 | MSGID | 0~255 | Server generated sequence number of downlink messages that need MSGID. Badge will respond ACK with this number, otherwise CS should resend the message. |

## 3.4.4 Acknowledge

Port: 13

| Bytes | 1 |
|-------|---|
| Item | MSGID |

MSGID field

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~0 | MSGID | 0~255 | The message id of corresponding uplink message, e.g. alarm report |

## 3.4.5 Locator beacon UUID

Used to configure locator beacon UUID list. To reset the configuration, UUID can be set as 0xffffff….

Port: 14

| Bytes | 1 | 1 | 1 | 16 | |
|-------|---|---|---|----|---|
| Item | MSGID | LENGTH | INDEX | UUID | … |

MSGID field

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~0 | MSGID | 0~255 | The message id of corresponding uplink message |

LENGTH field

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~3 | RFU | 0 | Reserved for Future Use. |
| 2~0 | LENGTH | 1~5 | The number of configured UUID. Currently the maximum supported UUID is five. |

INDEX field

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 7~3 | RFU | 0 | Reserved for Future Use. |
| 2~0 | INDEX | 0~4 | The index of the UUID in the list to be set. |

UUID field

| Bit | Name | Value | Description |
|-----|------|-------|-------------|
| 127~0 | UUID | | UUID. |

# 4. BLE Configuration

The working parameters of the device can be configured online through Lora network or by establishing BLE connection through APP. In addition, the device ID, Key, frequency, and working mode can only be changed through APP.

After the configuration is complete, disconnect the BLE connection and the device restarts automatically. Lora does not work during BLE connection.

## 4.1 Android System

### 4.1.1 Install tool

In Android, nrfConnect need to be installed, download address:
https://github.com/NordicSemiconductor/Android-nRF-Connect/releases

### 4.1.2 Connect Device

Turn on the phone's Bluetooth function and nrfConnect APP, then click the "Scan" button in the upper right corner. Long press the button to restart the badge. The badge can be connected to the APP for the first 30 seconds after the restart. After the timeout, need to restart the badge again.
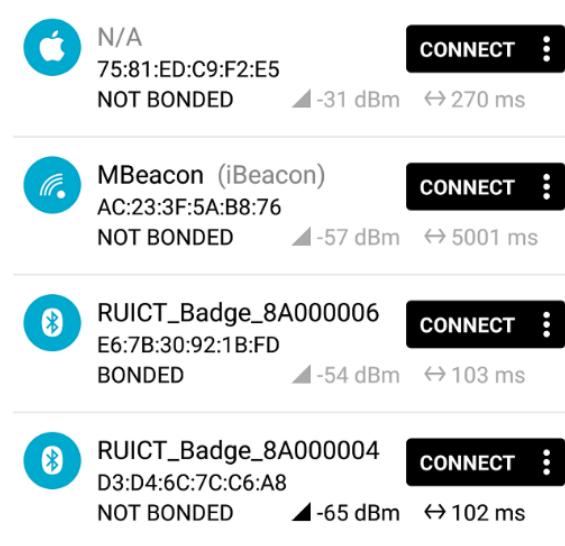


Find the tracker you want to configure, name format is RUICT_VEHICLE_device number. A password is required to establish a connection. The default password is 524354.

# 4.1.3 Parameters Configure
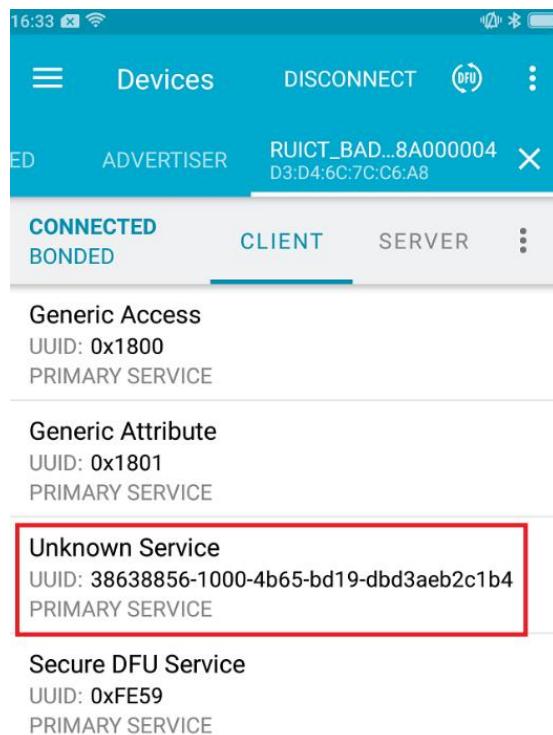


Select "Unknown Service" to enter configure panel.
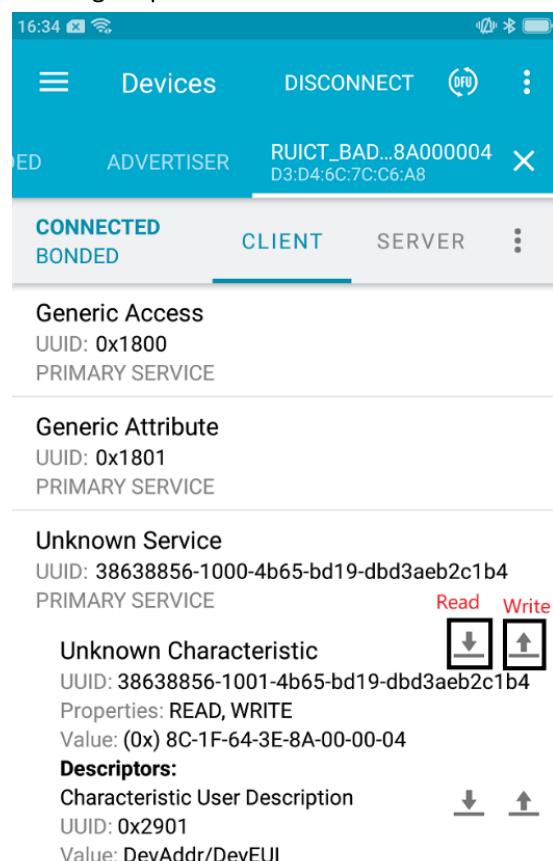


The following configuration items are supported：

| UUID | Items | Description |
|---|---|---|
| 38638856-1001-4b65-bd19-dbd3aeb2c1b4 | DevAddr/DevEUI | Read/Write |
| 38638856-1002-4b65-bd19-dbd3aeb2c1b4 | AppSkey/AppKey | Write |
| 38638856-1003-4b65-bd19-dbd3aeb2c1b4 | NwkSkey/AppEui | Write |
| 38638856-1004-4b65-bd19-dbd3aeb2c1b4 | Work Mode | Read/Write |
| 38638856-1005-4b65-bd19-dbd3aeb2c1b4 | Work Parameters | Read/Write |
| 38638856-1006-4b65-bd19-dbd3aeb2c1b4 | Connect Password | Write |
| 38638856-1007-4b65-bd19-dbd3aeb2c1b4 | 3$^{rd}$ Party Locator Beacon UUID | Read/Write |

No matter whether the device is in OTAA mode or ABP mode, fill in DevEUI. If the device is in ABP mode, the last 4 bytes are intercepted as DevAddr.

For security reasons, all keys are unreadable, and the Key in the device is encrypted. To set the Key in the network server, please contact us to obtain the unencrypted value.

**Work Mode**

The operating mode contains 4 bytes of data, which is used to set the standard and operating frequency of the device.

The format is AABBCCDD

**AA:** 00 indicates ABP mode, and 01 indicates OTAA mode

**BB:** Device scheme, 00: US915, 01: EU868, 02: AU915, 03: CN470, 04: AS923

**CC:** the starting frequency point.

The initial channel number of CN470 is 0, corresponding to 470.3M, and each frequency point occupies 0.2M frequency interval.

AS923 starts with a channel number of 0 and corresponds to a frequency point of 920.2M. Each frequency point occupies a frequency interval of 0.2M.

EU868 starts with a channel number of 0 and corresponds to a frequency point of 863.1M. Each frequency point occupies a frequency interval of 0.2M.

US915 starts with a channel number of 0 and corresponds to a frequency point of 902.3M. Each frequency point occupies a frequency interval of 0.2M.

AU915 starts with a channel number of 0 and corresponds to a frequency point of 915.2M. Each frequency point occupies a frequency interval of 0.2M.

**DD:** indicates the termination frequency.

For example, to set the 8 frequency points starting from 479.9m and OTAA mode, set it to 01033037. For AS923 the default mode is 01040110. For EU868 the default mode is 01010C1B. For US915 the default mode is 0100080F, i.e. band2. For AU915 the default mode is 0102080F.

**BLE connect password**

You can use this option to change the default BLE connection password. After changing the password, you need to remember the new password; otherwise, the Bluetooth connection cannot be established.

**3$^{rd}$ Party Locator Beacon UUID**

You can configure only one third-party Locator beacon over Bluetooth. To configure more UUID, you need to configure it remotely by Lora.

# 4.2 Apple System

Lightblue will make it even easier on iphones.

## 4.2.1 Connect Device

Connect the power cable to the tracker to restart the badge. The badge can be connected to the APP for the first 40 seconds after the restart. After the timeout, the tracker should be restarted again to reconnect.
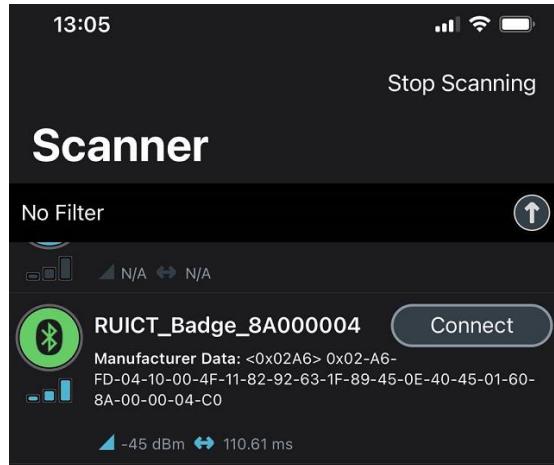


## 4.2.2 Parameters Configure

Find the device you want to configure and click "Connect" to connect the device. The APP will pop up a dialog box to prompt you to enter the password. The default password is "524354". After the connection is successful, enter the configuration interface, as shown in the figure below. The specific method is the same as the above nrfConnect method, which will not be described here.

# 5. OTA

The device can be upgraded by establishing a Bluetooth connection with nrfConnect. The nrfConnect interface on Android and iPhone is slightly different.

## 5.1 Android System

### 5.1.1 Install tool

Download address:
https://github.com/NordicSemiconductor/Android-nRF-Connect/releases

### 5.1.2 Upload firmware

Upload the upgrade package to any directory on the mobile phone.

# 5.1.3 Connect Device

Turn on the bluetooth function and APP of your phone and click the "Scan" button in the upper right corner. Long press the button to restart the badge. The badge can be connected to the APP for the first 30 seconds after the restart. After the timeout, you need to restart the badge again.
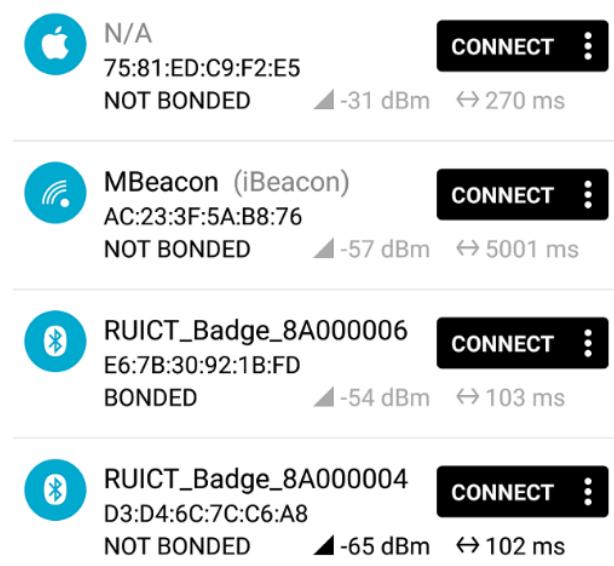
N/A
75:81:ED:C9:F2:E5
NOT BONDED          -31 dBm    270 ms
CONNECT

MBeacon (iBeacon)
AC:23:3F:5A:B8:76
NOT BONDED          -57 dBm    5001 ms
CONNECT

RUICT_Badge_8A000006
E6:7B:30:92:1B:FD
BONDED              -54 dBm    103 ms
CONNECT

RUICT_Badge_8A000004
D3:D4:6C:7C:C6:A8
NOT BONDED          -65 dBm    102 ms
CONNECT

Find the device you want to configure and click "Connect" to connect the device. The APP will pop up a dialog box to prompt you to enter the password. The default password is "524354".

## 5.1.4 Upgrade
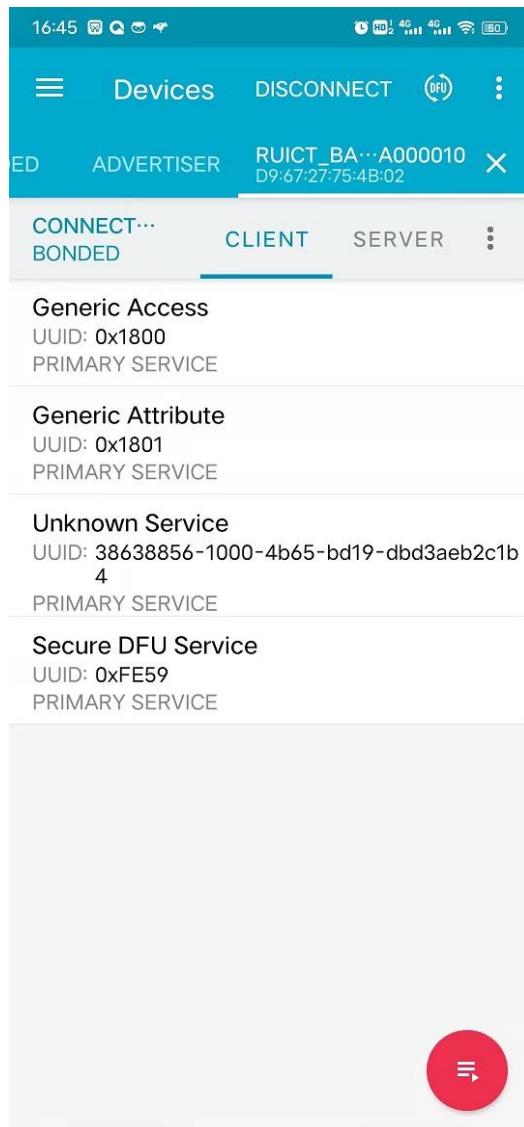


Click "DFU" in the upper right corner and select the ZIP file type.
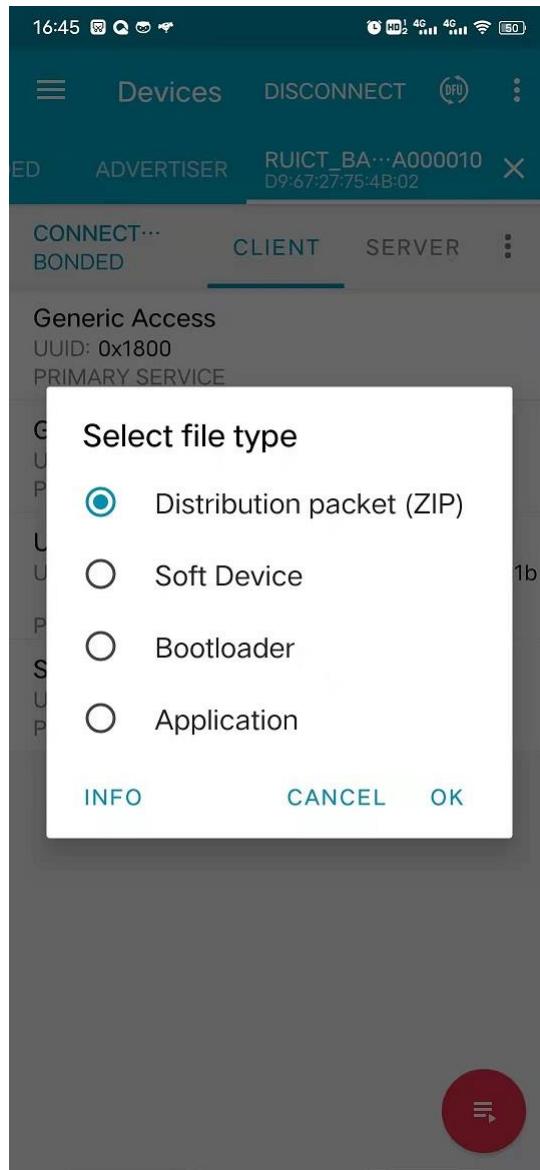
Locate the directory for saving the upgrade package and select the upgrade file.

## 5.2 Apple System

Apple phones also need to use nrfConnect to upgrade.

### 5.2.1 Upload Firmware

First send the upgrade package to wechat and open the upgrade package on wechat. You can also select other similar APP to import the firmware.
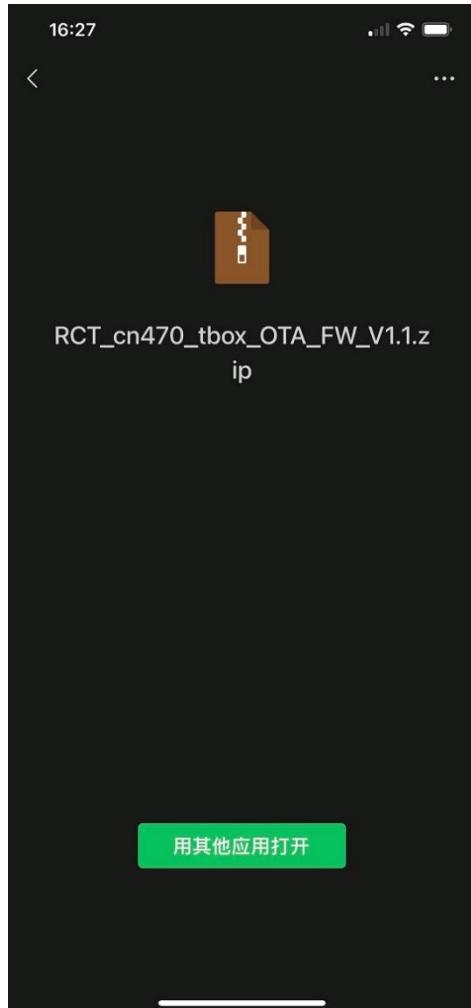
Select nrfConnect in the application that pops up, and the upgrade package is saved in nrfConnect.

## 5.2.2 Connect Device

Reboot the tracker. The badge can be connected to the APP for the first 40 seconds after the restart. After the timeout, the badge should be restarted again.
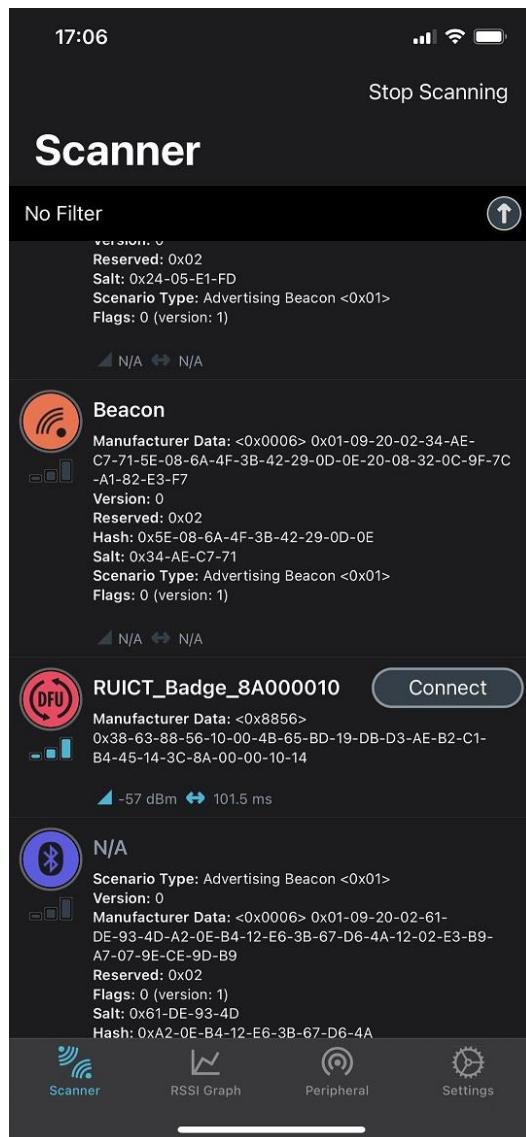
Click "Connect" to establish bluetooth connection.

### 5.2.3 Upgrade
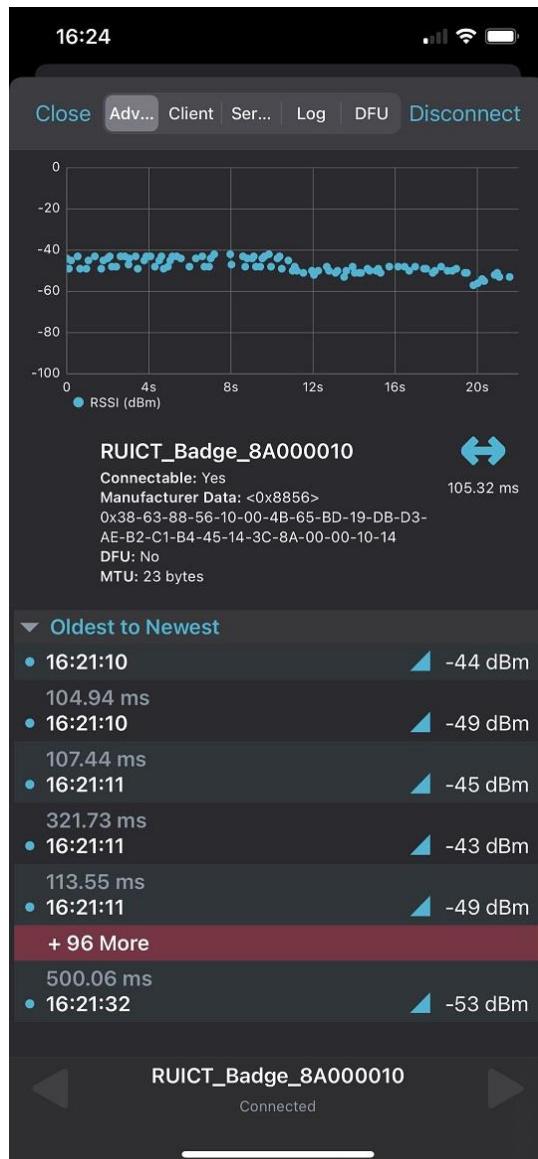


Click "DFU" in the upper right corner and select the corresponding upgrade package.

## 5.3 Batch upgrade

We provide hardware tool and PC based software to perform automatic batch upgrade. If you purchase more than 100 devices, please contact us(support@ruichuangte.com) for free software and hardware.

# 6. Mechanical structure



| Parameter | Value |
|---|---|
| Model | TD04 |
| Band | EU868/AS923/US915/AU915/IN868/KR920 |
| Transmit power | Maximum 22dBm, configurable |
| Protocol | LoraWAN1.0.3 |
| Join | OTAA，ABP |
| Positioning mode | BLE RSSI, GNSS L1/L5 |
| BLE band | 2.4GHz |
| BLE sensitivity | -92dBm, threshold can be set |
| BLE protocol | BLE5.0, it supports iBeacon protocol and any other BLE protocols |
| Battery | 6000mah rechargeable lithium battery |
| Charging mode | Solar |
| Solar panel | 5.5V,1.3W |
| Static standby | 50uA |
| Reporting interval | Configurable, minimum 5S reporting interval, sleep at night |
| Communication distance | Lora: 1.5km downtown, Bluetooth: 50m |
| Motion detection | Support, built-in motion sensor, intelligent sleep can be set |
| Online upgrade | Bluetooth, batch upgrade |
| Working temperature | -20℃ ～ 80℃ |
| Degree of protection | IP67 |
| Product size | 222mm x 66mm x 29mm（L x W x H） |
| Weight | 348g |
| Shell material | ABS |

# 7. Abbreviation

ABP: Activation By Personalization
ADR: Adaptive Data Rate
AGNSS: Assisted GNSS
BLE: Bluetooth Low Energy
CAS: Customer Application Server
CRC: Cyclic Redundancy Check
DR: Data Rate
GNSS: Global Navigation Satellite System
GPRS: General Packet Radio Service
LNS: LoRaWAN Network Server
LoRa: Long Range modulation technique
LoRaWAN: Long Range Network protocol
MAC: Medium Access Control
OTAA: Over-The-Air Activation
RSSI: Received Signal Strength Indicator
SOC: State Of Charge

# The End