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Catalog

1. General Introduction

This LoRa & BLE Device is designed based on BLE and LoRa technology. With the advanced LoRa technology and build-in BLE module, the LoRa & BLE Device detects the BLE beacon signal, and report to the LoRa Device. The parameters setting, such as heartbeat period, LoRa work mode is adjustable per customers' requirements.

Highlights:

- LoRaWAN 1.02 compliant

2 On/Off

The tracker can be turned on/off by long period pressing the power button for 3 seconds. When pushing the button to power off the tracker, the red light will last for three seconds then turn off, when push the button to power on the tracker, the red light will flash for four times then turn off.
Press the button to check whether the tracker is working, if the green "S" status light blinks, it indicates the tracker is working. The red battery light flashes during charging and sustains when charging completed.

3. Product Specifications

Table 1: Product Specifications

Positioning Mode	BLE4.0
Scan range	30m/50m
Protocol	LoRaWan
Sensitivity	-142.5dBm
Operating Current	6mAh@BLE receiving
	Max 140mA@19dBm
Operating Temperature	-40 ~ +70℃
Storage Temperature	-50 ~ +85℃
Operating Humidity	5% ~ 95%
Power Mode	DC 5V
Communication Distance	>1.5km in urban area
Application Context	Asset Management

4. Application Information

4.1 Function

There're two kinds of LoRa & BLE Device, one type is indoor Device powered by external power and no battery equipped, and another type is outdoor Device powered by solar panel equipped with Lithium battery or only battery equipped.
The Device supports both OTAA and ABP mode, both work in class a mode, the data rate is limited to start from DR2 to transmit big payload. DevEUI, AppEUI and AppKey, or DevAddr, NwkSKey and AppSKey are stored in the Device and are necessary for joining a network. DevEUI or DevAddr is labeled at the

back of the device. Lansitec will help to configure these parameters before shipping if necessary. After power on and join the Lora network, Device will send registration message which include the current parameters setting of the Device to Customer Server(CS). If CS doesn't reply Device will retry for 3 times before working in default mode.

Device starts to work after receiving acceptance response or no CS reply is received after 2 registration trials. The Device reports the heart beat message to CS periodically. The duty cycle is configurable by commands from CS. Coordinate acquisition and report period depends on the BLE scan results. 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, Device uses heartbeat message to control the downlink response time. The heartbeat period can be configured to be integral multiple of 30 seconds. The default period is 5 minutes. Heartbeat message also contains status information of the Device. It can be used by CS to monitor the Device.

4.2 Application Scenarios

The Device is managed with the following general rules:

- When registration request is received from the Device,
  - If CS only wants the Device to work with default parameters, CS ignores the registration message and waits for the periodically coordinate report.
  - Or CS should record the first-time configuration, acknowledge the request. If CS contains some history configuration of the Deviceand mismatch occurred, CS should send the new configuration to Device. Then Device updates and starts to work with these new parameters.

- After registration, configuration of the Device may be changed by user. CS needs to save the new parameters and CRC16 of the parameters. In case of receiving registration when Device reset or periodical heartbeat message, CS need to check if any configuration mismatch occurred. If necessary, CS should send the new configuration to Device in next downlink window.

4.3 Uplink Message

4.3.1 Register

Bytes	**1**	**1**	**1**	**1**	**2**	**1**	**2**
Item	TYPE	SMODE	POWER	CFG	POS	HB	CRC

TYPE field (the most significant byte)

Bit	Name	Value	Description
7~4	TYPE	0x1	Message type. CS can use it to identify different uplink messages. Bit7 is the significant bit.

3	ADR	0: OFF 1: ON	ADR (Adaptive Date Rate) status. The default value is OFF.
2~0	MODE	0x01~0x07	Current working scheme which should be one of SMODE. 0x1: AU920 0x2: CLAA 0x3: CN470 0x4: AS923 0x5: EU433 0x6: EU868 0x7: US915

SMODE field

Bit	Name	Value	Description
7~0	SMODE	0x01: AU920 0x02: CLAA 0x04: CN470 0x08: AS923 0x10: EU433 0x20: EU868 0x40: US915	Data scheme supported by Device. This field is preserved by Lansitec and will be configured before shipping. For European market, the default value is EU868, for China market, the default value is CN470, for Southeast Asia market, the default value is AS923, for America market, the default value is US915. Currently only support one kind of mode.

POWER field

Bit	Name	Value	Description
7~3	POWER	0~31	Configured transmit power. The default value depends on the Device working mode, it's always the biggest one of the allowed power. For example, if the mode is EU868, the default value of POWER should be 14dbm. (Unit: dBm)
2~0	Reserved	0x0	Reserved for future use. If MODE is CLAA, it indicates the frequency sweep mode of the Device: 1: A mode 2: B mode 3: C mode 4: D mode 5: E mode 6: All frequency sweep

CFG field

Bit	Name	Value	Description
7~4	DR	0~15	Data Rate(DR0~DR15). The default value is DR2. If ADR is disabled, the Device will work in this data rate.
3~0	Reserved	0x0	Reserved for future use.

POS field

Bit	Name	Value	Description
15~0	POS	0~65535	The period of position report, unit 5s. 0 means OFF. (Big endian) The default value is 10s.

The Device will start BLE scanning several seconds before the end of every scan period, the default value is 3 seconds, which is configurable. Besides, scan period and send period are different, the purpose is to reduce the send delay, that's because in some situation the outdoor Device may be configured to detect every 30 minutes or one hour, if still only send the data at the end of scan period, it will take hours to send all the beacons once there're tens of beacons. To solve this issue, the Device will check the scan period every time, if scan period is more than 5 minutes, after it sending the data at the end of scan period, it will go on checking the buffer, if still having beacons not sent it will launch another transmission 10 seconds later till all the beacons are sent.

HB field

Bit	Name	Value	Description
7~0	HB	1~255	The period of Heartbeat message, unit 30s. Heartbeat can't be disabled. The default value is 10.

CRC field

Bit	Name	Value	Description
15~0	CRC		CRC16 of previous fields with TYPE bits set to 0, the polynomial is $x^{16}+x^{15}+x^2+1$. CS only need to compare this data field with the CS stored one to judge whether configuration changed.

Default value of Device configuration depends on specific products.

4.3.2 Heartbeat

Bytes	**1**	**1**	**1**	**2**	**1**	**1**	**2**
Item	TYPE	VOL	RSSI	SNR	RFU	CHGSTAT	CRC

TYPE field

Bit	Name	Value	Description
7~4	TYPE	0x2	Message type, CS can use it to identify different uplink messages.
3~0	Version	1	Version of the message type, current version is 1.

VOL field

Bit	Name	Value	Description
7~0	VOL	0~100	Battery capability, it indicates how much capability left. If the Device is indoor type, this filed will be 0. (Unit: %)

RSSI field

Bit	Name	Value	Description
7~0	RSSI	0~160	The downlink Received Signal Strength Indication, detected and calculated by the Device. (Unit: -1dBm)

SNR field

Bit	Name	Value	Description
2Bytes	SNR	-3000~3000	Signal Noise Ratio, *0.01, i.e. -30.00~30.00

RFU field

Bit	Name	Value	Description
7~0	RFU	0x0	Reserved for Future Use.

CHGSTAT field

Bit	Name	Value	Description
7~0	CHGSTAT	0x0: Not charging 0x5: Charging 0x6: Charge completed	Status of battery.

CRC field

Bit	Name	Value	Description
15~0	CRC		Same CRC16 as calculated in register message. This can be used for server to check if any configuration mismatch.

4.3.3 Beacon

For BLE beacons which broadcast major and minor instead of MAC.

Bytes	**1**	**2**	**2**	**1**	**2**	**2**	**…**	**N**				
Item	TYPE	MAJOR	MINOR	RSSI	MAJOR	MINOR	…	TOFF				
								Byte0		Byte1		…
								B0	B1	B2	B3	

TYPE field

Bit	Name	Value	Description
7~4	TYPE	0x8	Message type, CS can use it to identify different

			uplink messages.
3~0	LENGTH	M(1~15)	The number of scanned beacons in this message. That means in one message, at most 15 beacons can be transmitted. If there're more than 15 beacons, they'll be transmitted 15 by 15. In one second, about 100 beacons can be scanned by the Device.

MAJOR field

Bit	Name	Value	Description
15~0	MAJOR	short	Major of BLE beacon.

MINOR field

Bit	Name	Value	Description
15~0	MINOR	short	Minor of BLE beacon.

RSSI field

Bit	Name	Value	Description
7~0	RSSI	byte	Received Signal Strength Indication of the beacon, the server utilizes it to calculate the distance. (unit: -1dBm)

TOFF field

Bytes	Name	Value	Description
N	TMOFF		Time offset means the delta between the time every beacon scanned and the time message sent. N = (M+1) / 2 Byte0: bit7 bit6 bit5 bit4 | bit3 bit2 bit1 bit0 Beacon0 | Beacon1 Byte1: bit7 bit6 bit5 bit4 | bit3 bit2 bit1 bit0 Beacon2 | Beacon3 … Example: If there's 4 beacons in the message, then M will be 4, and N will be 2. Suppose the message is sent at 15:04:27, the beacon1 is scanned at 15:04:25, beacon2 at 15:04:23, beacon3 at 15:04:26, beacon4 at 15:04:27, then TMOFF should be 0x2410. This field is designed for precise positioning, if a beacon is scanned by multi Devices at the same time, the server can calculate the distance between the beacon and Devices, then calculate the position of the beacon.

4.3.4 Bracelet

Bytes	**1**	**6**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**..**	**N**
Item	TYPE	MAC	HB	STEPS	BAT	SYSP	DIAP	CALO	RSSI	SOS	..	TOFF

TYPE field

Bit	Name	Value	Description
7~4	TYPE	0x9	Message type, CS can use it to identify different uplink messages.
3~0	LENGTH	1~6	The number of scanned beacons in this message

MAC field

Bit	Name	Value	Description
47~0	MAC		Mac of bracelet

HB field

Bit	Name	Value	Description
7~0	HB	byte	Heartbeat Records the heart beat rate of the person who wear the bracelet.

STEPS field

Bit	Name	Value	Description
15~0	STEPS	short	Movement steps

BAT field

Bit	Name	Value	Description
7~0	BAT	0~100	Battery (percentage)

SYSP field

Bit	Name	Value	Description
7~0	SYSP	byte	Systolic Pressure

DIAP field

Bit	Name	Value	Description
7~0	DIAP	byte	Diastolic Pressure

CALO field

Bit	Name	Value	Description
15~0	CALO	short	Number of calories consumed (Unit: Calorie)

RSSI field

Bit	Name	Value	Description
7~0	RSSI	byte	Received Signal Strength Indication of bracelet, the server utilizes it to calculate the distance. (Unit: -1dbm)

SOS field

Bit	Name	Value	Description
7~0	SOS	byte	SOS(Not used currently)

TOFF field

Refer to 4.3.3

4.3.5 Light perception

For BLE beacons which detect and report light change.

Bytes	**1**	**6**	**2**	**1**	**1**	**…**	**N**
Item	TYPE	MAC	LIGHT	BAT	RSSI	…	TOFF

TYPE field

Bit	Name	Value	Description
7~4	TYPE	0xA	Message type, CS can use it to identify different uplink messages.
3~0	LENGTH	M(1~10)	The number of scanned beacons in this message

MAC field

Bit	Name	Value	Description
47~0	MAC		Mac

LIGHT field

Bit	Name	Value	Description
15~0	LIGHT	short	Intensity of light. (Unit: Lux)

BAT field

Bit	Name	Value	Description
7~0	BAT	1~100	Battery left(Unit: percentage)

RSSI field

Bit	Name	Value	Description
7~0	RSSI	byte	Received Signal Strength Indication of the sensor, the server utilizes it to calculate the distance. (Unit: -1dbm)

TOFF field
Refer to 4.3.3

4.3.6 G-Sensor

For BLE beacons which detect and report movement.

Bytes	**1**	**6**	**2**	**2**	**2**	**1**	**1**	**…**	**N**
Item	TYPE	MAC	X	Y	Z	BAT	RSSI	…	TOFF

TYPE field

Bit	Name	Value	Description
7~4	TYPE	0xB	Message type, CS can use it to identify different uplink messages.
3~0	LENGTH	M(1~7)	The number of scanned beacons in this message

MAC field

Bit	Name	Value	Description
47~0	MAC		Mac

X field

Bit	Name	Value	Description
15~0	X	Short -1 ~ 1	Accelerometer in X-axis. (Unit: g)

Y field

Bit	Name	Value	Description
15~0	Y	Short -1 ~ 1	Accelerometer in Y-axis. (Unit: g)

Z field

Bit	Name	Value	Description
15~0	Z	Short -1 ~ 1	Accelerometer in Z-axis. (Unit: g)

BAT field

Bit	Name	Value	Description
7~0	BAT	1~100	Battery (Unit: percentage)

RSSI field

Bit	Name	Value	Description

7~0	RSSI	byte	Received Signal Strength Indication of the sensor, the server utilizes it to calculate the distance. (Unit: -1dbm)

TOFF field
Refer to 4.3.3

4.3.7 Beacon List

For this message, it may contain at least two kinds of the messages described in 4.3.3,4.3.4,4.3.5 and 4.3.6.

Bytes	**1**	**1**	**N**	**…**
Item	TYPE	MSGTYPE	MSGBODY	…

TYPE field

Bit	Name	Value	Description
7~4	TYPE	0xD	Message type, CS can use it to identify different uplink messages.
3~0	LENGTH	M(1~4)	The number of scanned beacons type in this message

MSGTYPE

Bit	Name	Value	Description
7~4	MSGTYPE		Message type. 1: Beacon 2: Bracelet 3: Light perception 4: G-Sensor
3~0	LENGTH	1~15	Message length

MSGBODY

Bit	Name	Value	Description
N	MSGBODY		Refer to charter 4.3.3,4.3.4,4.3.5,4.3.6 for the details.

4.3.8 Alarm

Bytes	**1**	**1**
Item	TYPE	MSGID

TYPE field

Bit	Name	Value	Description

7~4	TYPE	0x6	Message type, CS can use it to identify different uplink messages.
3~0	ALARM	0	Not used

MSGID field

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

4.3.9 Acknowledge

Bytes	**1**	**1**
Item	TYPE	MSGID

TYPE field

Bit	Name	Value	Description
7~4	TYPE	0xF	Message type, CS can use it to identify different uplink messages.
3~0	RESULT	0: success 1: failure	Process result of any downlink message that need acknowledge.

MSGID field

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

4.4 Downlink Message

4.4.1 Register acceptance

Bytes	**1**
Item	TYPE

TYPE field

Bit	Name	Value	Description
7~4	TYPE	0x1	Message type, Device can use it to identify different downlink messages.
3~0	RESULT	0: success 1: illegal Device 2: server busy	Register result. In current Device, if the result is not 0, Device will go on sending Register

			message.

4.4.2 Lora configuration

Bytes	**1**	**1**	**1**
Item	TYPE	DR	MODE

TYPE field

Bit	Name	Value	Description
7~4	TYPE	0x8	Message type, Device can use it to identify different downlink messages.
3	ADR	0: OFF 1: ON	ADR (Adaptive Date Rate) status.
2~0	Reserved	0x0	Reserved for future use. If MODE is CLAA, it indicates the frequency sweep mode of Device: 1: A mode 2: B mode 3: C mode 4: D mode 5: E mode 6: all frequency sweep

DR field

Bit	Name	Value	Description
7~4	DR	0~15	Data Rate(DR0~DR15). If ADR is on, this value will not take effect. If ADR is off, the Device will work in this data rate.
3~0	Reserved	0	Reserved for future use

MODE field

Bit	Name	Value	Description
7~5	MODE	0x1:AU920 0x2:CLAA 0x3:CN470 0x4:AS923 0x5:EU434 0x6:EU868 0x7:US915	Configure mode. Can’t change currently.
4~0	POWER	0~31	Configure transmit power (unit dBm)

4.4.3 Device configuration

Bytes	**1**	**2**	**1**

Item	TYPE	POS	HB

TYPE field

Bit	Name	Value	Description
7~4	TYPE	0x9	Message type, Device can use it to identify different downlink messages.
3~0	Reserved	0x0	Reserved for future use.

POS field

Bit	Name	Value	Description
15~0	POS	0~65535	The period position report, unit 5s. 0 means OFF. (Big endian)

HB field

Bit	Name	Value	Description
7~0	HB	1~255	The period of Heartbeat message, unit 30s. This value must be larger than 0.

4.4.4 Command request

Bytes	**1**	**1**	**1**
Item	TYPE	MSGID	VALUE

TYPE field

Bit	Name	Value	Description
7~4	TYPE	0xA	Message type, Device can use it to identify different downlink messages.
3~0	COMMAND	0x2: register request 0x3: device reset 0x4:Stop scanning BLE 0x5:Start scanning BLE 0x6:Change scan starting time 0x7:Change scan period	Requested command. 0x2 used to request the Device to send register message. 0x3 used to reset the Device. 0x4 used to stop continuous scanning BLE, only enable scanning function 3 seconds ahead of sending. This feature is only suitable for outdoor Device, for indoor Device it always scan BLE. 0x5 used to start continuous scanning BLE. 0x6 used to advance or delay the scan starting time. 0x7 used to change scan time for outdoor Device, the default scan time is 3 seconds.

MSGID field

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

VALUE field

Bit	Name	Value	Description
7~0	VALUE	-127~127	If command is 6, this filed is used to set the value of advancing or delaying time. If the value is positive the scan starting time will delay, else will advance. If command is 7, this field is use to set the value of the new scan time.

4.4.5 Acknowledge

Bytes	**1**	**1**
Item	TYPE	MSGID

TYPE field

Bit	Name	Value	Description
7~4	TYPE	0xF	Message type, Device can use it to identify different downlink messages.
3~0	Reserved	0x0	Reserved for future use.

MSGID field

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

4.5 Performance test and work mode

Below is a test Lansitec perform, for your reference.

a) Beacon transmit interval: 500ms
b) 100 Beacons
c) Distance between beacons and GW: 2m
d) GW BLE function is always on
e) Maximum Beacon qty support: 500
f) 15 beacon information is sent to LoRa GW in every transmission.
g) BLW GW transmit interval: 10s (5s, 10s, 15s, 20s……are supported too)

Results:

All information of 100 beacons are received by BLE GW within the first 1.5s.
All information of 100 beacons are received by LoRa GW within 60 seconds.

If more beacons are received during this round (it's 60 seconds in this case), they are put at the end of the stack and will be transmitted after the 95th beacon (for example) in the next round.

If some left the effective range of the GW during this round (they are received at the beginning of this round), their information will still be sent to LoRa GW. But won't be sent in the next round.

If no more no less is found, everything will be sent again in the next round.

FCC Statement

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment .This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.