

WM-N-BM-22

Lite Lora-gateway User Guide

Version: 1.0

Universal Global Scientific Industrial Co., Ltd.		Doc No.		Rev	1.0
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Amendment Records

Item:	Date:	Revision:	Page:	Change Description:	Changed by:
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1. Overview

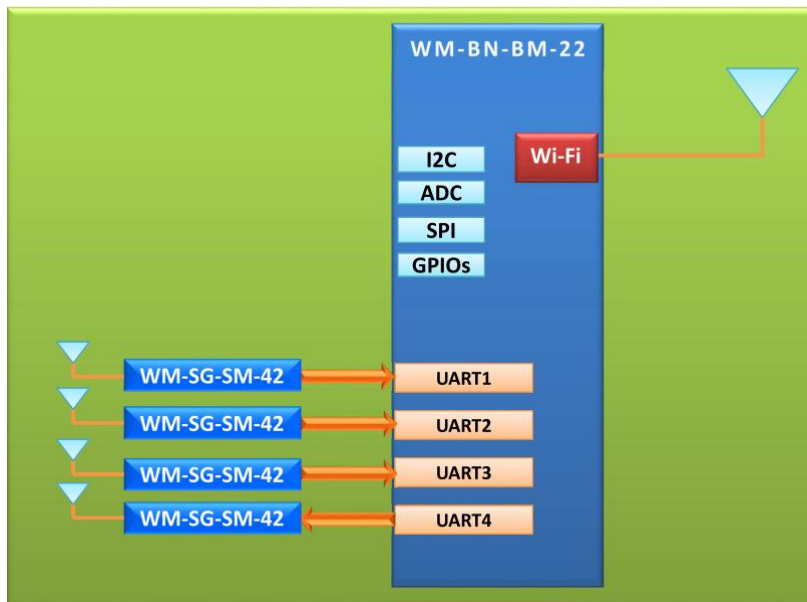
This document is for introduce the lite-gateway and how to set it up.

1.1 The features of the lite-gateway

- Packet forward for LoraWAN Class C compatible devices with ABP activation protocol
- EU868 & US915 Band
- Multiple I/O Function
 - SPI x 1
 - I2C x1
 - ADC x 3
 - PWM x 2
- Integrated with WiCED SDK

1.2 The hardware block diagram

The WM-N-BM-22 integrated IEEE 802.11b/g/n and BT4.1, it can connect 4 WM-SG-SM-42 Lora modules in maximum, and works as a network bridge for Wi-Fi and Lora. The gateway also provides multi IO function like I2C, SPI, GPIO and ADC which could be used for various IOT applications.



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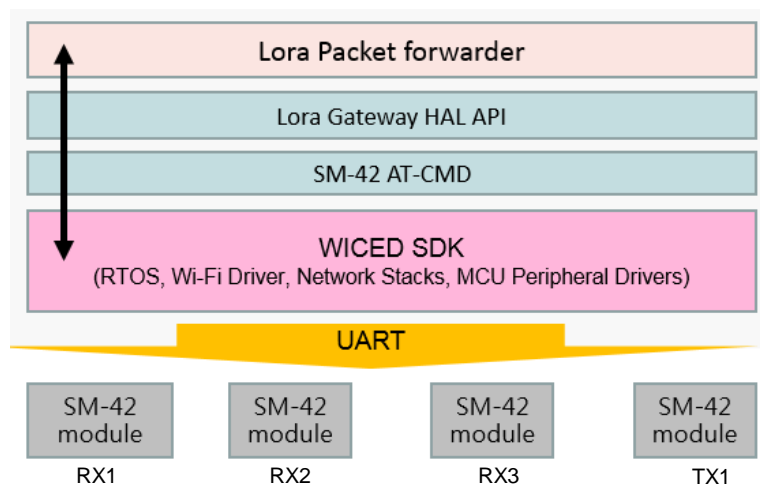
1.3 The software overview

The WM-BN-BM-22 provides rich software libraries based on the WiCED SDK for various IOT applications. There are 3 additional software parts for support the basic function for the lite Lora gateway.

SM-42 AT-CMD: this is used for control the four SM-42 modules through UART interface.

Lora Packet forwarder: this is used for forwarding nodes data to/from cloud server.

Lora Gateway HAL API: this is the Lora concentrator hardware abstraction layer API defined by Semtech, the purpose is for distinguish between the hardware driver (SM-42-AT-CMD) and software application (Lora Packet forward).



1.4 The software versions

The followings shows the required software version for this lora-gateway.

WM-N-BM-22:

- ◆ WICED SDK 4.x version above
- ◆ WM-N-BM-22 platform patch for lite Lora-gateway
- ◆ WM-N-BM-22 lit Lora-gateway Software Package v1.0

WM-SG-SM-42:

- ◆ WM-SG-SM-42 firmware version v3.0 above

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2 Setup the lite Lora-gateway

2.1 Install the software packages

2.1.1 Install WiCED SDK

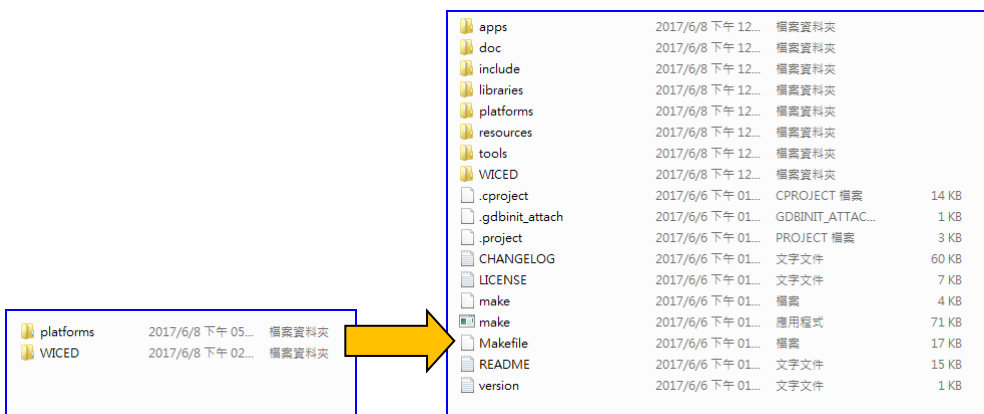
1. The lite gateway software package is developed with the WiCED SDK 4.x, please download WiCED SDK version 4.x from cypress web site and finish the installation.

<https://community.cypress.com/community/wiced-wifi/wiced-wifi-documentation>

2.1.2 Install the platform patch for WM-N-BM-22

1. Please get the WiCED platform patch for WM-N-BM-22 from the contact window of the product.
2. Unzip the platform patch package into the root path of WICED SDK as below:

◆ \$(WICED_SDK_ROOT_PATH)\43xxx_Wi-Fi\



2.1.3 Install the lite Lora-gateway software package

1. Please download the latest lite-gateway software package from the from the GitHub link below:

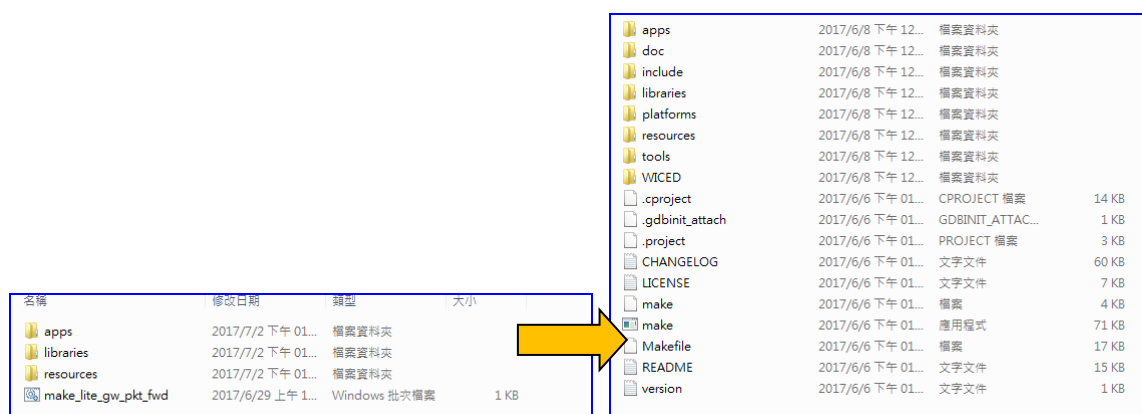
https://github.com/USILoRaModule/USI_BM-22-Lite-LoRa-Gateway/blob/master/WM-N-BM-22_lite_lora-gateway_software_package_v1.0.zip

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2. Unzip the platform patch package into the root path of WICED SDK as below:

\$\{WICED_SDK_ROOT_PATH\}\43xxx_Wi-Fi\



2.2 The configuration of packet forwarder

The related configuration about the packet forwarder was defined in the source files below, they also can be changed depended on the application requirements.

◆ \$\{WICED_SDK_ROOT_PATH\}\43xxx_Wi-Fi\apps\snip\lora_lite_gw_pkt_fwd\lite_gw_pkt_fwd.c

By the default, the lite Lora-gateway will forward Lora packets to TTN (the things network), the URL and UDP port was defined in this file as below, you can change them depended on the application requirements.

```

18
19 #define PKT_FWD_TARGET_URL "router.eu.thethings.network"
20 #define PKT_FWD_DLINK_PORT 1700
21 #define PKT_FWD_ULINK_PORT 1700

```

```

22
23 #if 0
24 #define PKT_FWD_TARGET_URL "192.168.11.7"
25 #define PKT_FWD_DLINK_PORT 1680
26 #define PKT_FWD_ULINK_PORT 1680
27 #endif
28

```

◆ \$\{WICED_SDK_ROOT_PATH\}\43xxx_Wi-Fi\libraries\lora_gateway\lib_legacy_pkt_fwd\legacy_pkt_fwd.h

The gateway ID is simply defined in a constant value as below, you can change it at here.

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```

6
7
8 #define THE_GATEWAY_ID "\xFF\xFE\x02\x0A\xF7\x58\x20\x9D"
9
10 int init_legacy_pkt_fwd( wiced_interface_t intf, char *host_ip
11 wiced_result_t pull_legacy_pkt( struct lgw_pkt_tx_s *lrx_pkt )
12 int request_pull_legacy_pkt( void );
13 int push_legacy_pkt( struct lgw_pkt_rx_s *p );
14
15

```

2.3 Make & Download the lite Lora-gateway firmware into WM-N-BM-22

1. The WICED SDK build system uses OpenOCD + FTDI USB JTAG device for download the images on the WM-N-BM-22 EVB. Since the lite Lora-gateway just reserves a 5 pins JTAG interface for download the images, so the following shows how to modify the build system for download the images on the WM-N-BM-22 via ST-Link programmer.

a) Open file \$(WICED_SDK_ROOT_PATH)\43xxx_Wi-Fi\tools\makefiles\wiced_toolchain_common.mk in WICED Eclipse IDE or text editor.

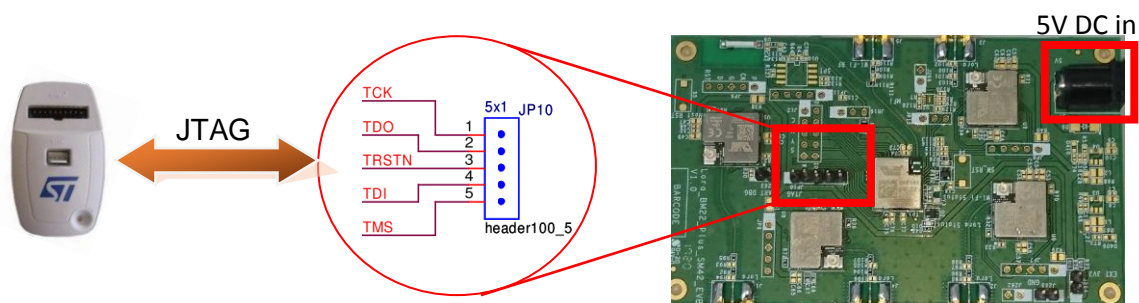
b) Please comment out this line which contains the description 'JTAG ?= BCM9WCD1EVAL1' (near by line #38) and insert a line contains the description below:

```

32
33 TOOLS_ROOT ?= $(SOURCE_ROOT)tools
34
35 OPENOCD_PATH := $(TOOLS_ROOT)/OpenOCD/
36 PATH :=
37
38 #JTAG      ?= BCM9WCD1EVAL1
39 JTAG      ?= stlink-v2-1
40
41

```

c) Connect ST-LINK programmer to the JP10 on the lite Lora-gateway as below:



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2. Open a command window and change the working directory to the path below:

`$(WICED_SDK_ROOT_PATH)\43xxx_Wi-Fi\`

3. Build all the code of lite Lora-gateway by using the command below:

`make_lite_gw_pkt_fwd.bat`

4. Download and run the lite Lora-gateway on WM-N-BM-22 by using the command below:

`make_lite_gw_pkt_fwd.bat download run`

2.4 Initial the Wi-Fi network and Lora transmitter and receivers

WICED SDK provides a device configuration code to demonstrating how to configure WICED device to join a Wi-Fi network via Soft AP and a web page, this Lora-gateway leverages the device configuration function to demonstrating the initial functions, the gateway will run in (or return to) this configuration mode at the following situations:

- ◆ The first time to run the lite Lora-gateway software on the BM-22
- ◆ Rerun make & download command without `no_dct` parameter

At the configuration mode, we can configure the BM-22 to join a Wi-Fi network for internet or intranet connections and configure the SM-42 modules in the best operation mode for the lite gateway.

2.4.1 Connect to the soft AP and the setup webpage

- 1) Connect the device using Wi-Fi to the soft AP 'WICED_Config'
The soft AP name and password is: 'WICED_Config' and '12345678'
- 2) Open a web browser and enter '192.168.0.1' in the URL, and then the device configuration webpage appears.
(192.168.0.1 is the IP address of the soft AP interface)

2.4.2 Initial Lora transmitter and receivers

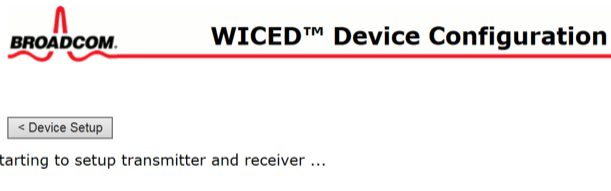
- 1) Click the LoraGW Setup button on this configuration home page.

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2) A Lora Device Setup page appears and transmitter and receiver configuration is proceed as below.



3) Please wait for a while until the configuration completed, and you will get the log as below if setup completed with no any error.

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< Device Setup

Starting to setup transmitter and receiver ...

Starting to setup the module on UART-2

lm_setup_modem(): the SW version for LRWAN and FW on UART-2: 1.0.1 , 0.2.9
 lm_setup_modem(): set baud rate 230400 for UART-2
 lm_setup_modem(): set 32MHz System Clock for UART-2
 lm_setup_modem(): Save changes on UART-2

Finished the setup for UART-2

Starting to setup the module on UART-0

lm_setup_modem(): the SW version for LRWAN and FW on UART-0: 1.0.1 , 0.2.9
 lm_setup_modem(): set baud rate 230400 for UART-0
 lm_setup_modem(): set 32MHz System Clock for UART-0
 lm_setup_modem(): Save changes on UART-0
 Finished the setup for UART-0

Starting to setup the module on UART-3

lm_setup_modem(): the SW version for LRWAN and FW on UART-3: 1.0.1 , 0.2.9
 lm_setup_modem(): set baud rate 230400 for UART-3
 lm_setup_modem(): set 32MHz System Clock for UART-3

lm_setup_modem(): Save changes on UART-3
 Finished the setup for UART-3

Starting to setup the module on UART-1

lm_setup_modem(): the SW version for LRWAN and FW on UART-1: 1.0.1 , 0.2.9
 lm_setup_modem(): set baud rate 230400 for UART-1
 lm_setup_modem(): set 32MHz System Clock for UART-1
 lm_setup_modem(): Save changes on UART-1
 Finished the setup for UART-1

lgw_setup(): setup was finished with no errors

Setup Stopped!

3) Click the device setup button for back to the device setup page (the configuration home page)



WICED™ Device Configuration

< Device Setup

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2.4.3 Setup Wi-Fi network

- 1) Click the Wi-Fi Setup button on the configuration home page.



- 2) A Wi-Fi Setup webpage appears and scanning the Wi-Fi networks in the range and then will show the scan result in a list.

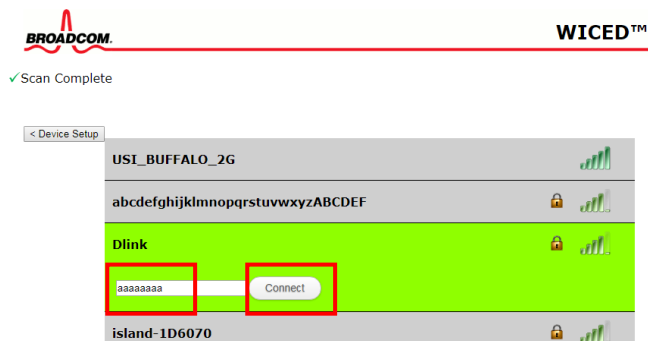


- 3) Find and click on a Wi-Fi AP which you want to join from the list and a password box will appear as below:

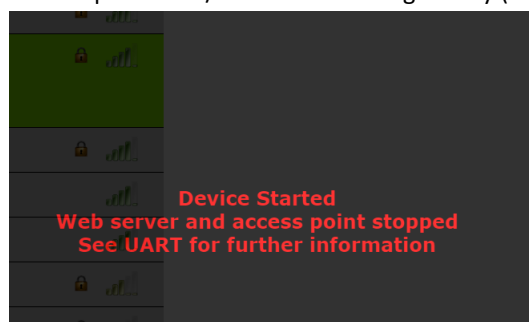


- 4) Enter the password for the Wi-Fi AP in the password box, and then click button 'Connect'

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- 5) Wi-Fi setup is completed if you saw the screen as below, the Lora-Gateway will being to forwarding the Lora packets to/from the remote gateway (TTN) after a repower.



- 6) In order to avoid resetting these Wi-Fi setting in the image update later, please add a parameter 'no_dct' at the end of make command.

2.4.4 Update WM-SG-SM-42 preloaded software

The Lora-gateway can connect 4 SM-42 modules in maximum, and the preloaded software version must be 3.0 above. When you get an error message about the incorrect SM-42 firmware version when initial the Lora the transmitter/receivers (as below), please refer to the preloaded software update application note to complete the firmware update.

- ◆ The SM-42 preloaded software v3.0 link:

https://github.com/USILoRaModule/USI_I-NUCLEO-LRWAN1/blob/master/preloaded_firmware/wm-sg-sm-42_firmware_v3.0.hex

- ◆ The SM-42 preloaded software update manual link:

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https://github.com/USILoRaModule/USI-I-NUCLEO-LRWAN1/blob/master/preloaded_firmware/WM-SG-SM-42%20Update%20Preloaded%20AT%20Command%20FW%20Application%20Note%20rev.%201.2.pdf



WICED™ Device Co

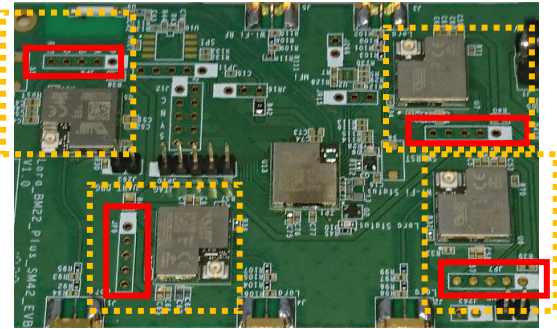
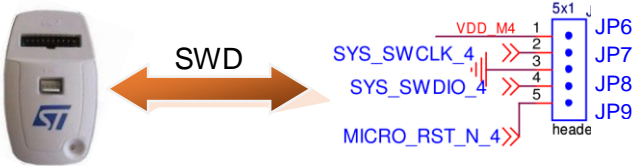
< Device Setup

Starting to setup transmitter and receiver ...

Starting to setup the module on UART-2

lm_setup_modem(): the SW version for LRWAN and FW on UART-2: 1.0.1 , 0.2.9
lm_setup_modem(): the fw version of the device is too old.
Finished the setup for UART-2

- ◆ The preloaded software package v3.0 and the update application note can be downloaded from the URL below:
- ◆ The SWD interfaces mapping to each SM-42 module is as below:



2.5 Test the lite Lora-gateway

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2.5.1 Monitoring debug log

By the default, all the debug log from the gateway application will be forwarded to UDP port 50007, a python script can be used for show the debug log. The file is located at the root path of WICED SDK as below:

\$(WICED_SDK_ROOT_PATH)\43xxx_Wi-Fi\udp_receive.py

♦ The following is the snapshot of the debug log from the UDP port, the begin of each line is the device IP address and the line number of log

```

(x.x.x.9:00000038) resp_OK(): got 12th OK.
(x.x.x.9:00000039) ---lrm_init()
(x.x.x.9:0000003A) +++lrm_init()
(x.x.x.9:0000003B) +++atcmd_init_uart()
(x.x.x.9:0000003C) atcmd_init_uart(): use default configuration for UART-0.
(x.x.x.9:0000003D) atcmd_init_uart(): allocating memory for UART-1 RX.
(x.x.x.9:0000003E) atcmd_init_uart(): allocating memory for UART-0 TX.
(x.x.x.9:0000003F) ---atcmd_init_uart()
(x.x.x.9:00000040) atcmd_add_console(): allocating CMD buffer for UART-0
(x.x.x.9:00000041) atcmd_add_console(): uses default size of CMD buffer for UART-0
(x.x.x.9:00000042) atcmd_add_console(): uses default size for RESP buffer on UART-0
(x.x.x.9:00000043) lrm_set_op_nodem(): set op mode at 9

```

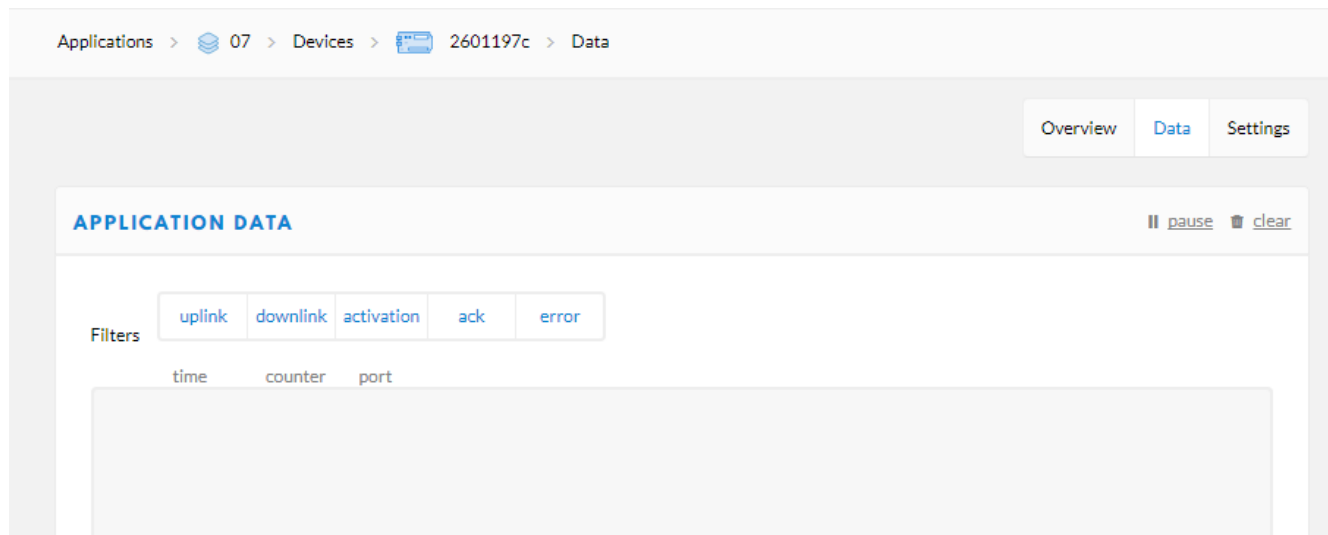
2.5.2 Test Packet forwarding on TTN

The followings demonstrates how to forwarding packets to/from TTN using the lite Lora-gateway and a standalone SM-42 module.

- 1) Please register a virtual gateway and application on TTN and open the device data webpage for monitor the traffic between the lite gateway and the virtual gateway on the TTN.
(There is an example of registration in section 4, you can refer this example to create the gateway and application on TTN for this test)

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2) Join SM-42 module to the lite Lora-gateway using the command sequence below:

```
# ATZ
# AT+DR=3
# AT+RX2DR=3
# AT+CLASS=2
# AT+DC=0
# AT+JOIN=0
```

3) Transmit a packet from the SM-42 module to the application on TTN using the command below:

```
# AT+SEND=7 12345678 0
```

4) Then the packet from the SM-42 appears on the TTN device data webpage, it means the uplink is no problem. The next, please click the button 'Overview' for back to the device webpage.

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Applications > 07 > Devices > 2601197c > Data

OverviewDataSettings

APPLICATION DATA

Filters

uplink
downlink
activation
ack
error

timecounterport

▲ 20:21:1537payload: 12 34 56 78

▲ 20:21:0827payload: 12 34 56 78

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5) Please fill the data by follow the red box below:

6) Transmit a packet from the SM-42 module to the application on TTN using the command below:

```
# AT+SEND=7 12345678 0
```

7) And then SM-42 reports a +RCV event as below on the UART console, it means the downlink is no problem.

```
+RCV=1,6,ABCDEF123456
```

2.5.3 Packet forwarding history webpage

The lite Lora-gateway built-in a webpage for review the packet forwarding history, just enter the IP address of the Lora-gateway in the URL of web browser, you can see the packet history either downlink and uplink.

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← → ↺ ① 192.168.0.117/lite_gw_web/index.html
應用程式 將書籤放置在書籤列上，即可快速前往各個網頁，立即匯入書籤...

WM-N-BM-22 Lora Gateway Demonstration

Packet forwarder History Application Gateway Status	Packet Forwarding History							
	Time	Channel	CR	Datarate	SEQ	DevAddr	Size	Payload
	U 06:16:54	868.1	4/5	SF9BW125	9	26011600	17	40 00 16 01 26 00 09 00 07 AF CB 9B F4 DE E2 E4 A7
	U 06:11:17	868.3	4/5	SF9BW125	8	26011600	29	40 00 16 01 26 00 08 00 02 98 EA CB C8 F7 21 31 94 17 03 45 3F 22 2B 0A FB B3 74 51 68
	U 06:11:12	868.1	4/5	SF9BW125	7	26011600	29	40 00 16 01 26 00 07 00 02 1B 7B EA 2E 55 12 87 26 4D C2 52 51 7B 6A 12 99 FB 23 9C A2
	U 06:11:08	868.1	4/5	SF9BW125	6	26011600	29	40 00 16 01 26 00 06 00 02 BA B9 AF 90 28 3C C0 73 5A 6E CB 6D 8E 82 D1 A5 CF AC 90 E3
	U 06:10:58	868.1	4/5	SF9BW125	5	26011600	17	40 00 16 01 26 00 05 00 07 F0 75 38 A0 AA 77 8E F3
	U 06:10:14	868.1	4/5	SF9BW125	4	26011600	17	40 00 16 01 26 00 04 00 07 A9 A4 99 01 72 2D C5 EF
	U 06:10:08	868.1	4/5	SF9BW125	3	26011600	17	40 00 16 01 26 00 03 00 07 F8 69 82 8A FF 95 46 54
	U 06:09:16	868.1	4/5	SF9BW125	2	26011600	17	40 00 16 01 26 00 02 00 07 97 A4 FD 03 67 91 C2 B5
	U 06:08:57	868.3	4/5	SF9BW125	1	26011600	17	40 00 16 01 26 00 01 00 07 A1 AE FF 44 72 5E EE 96
	U 06:08:14	868.3	4/5	SF9BW125	7	26011600	17	40 00 16 01 26 00 07 00 07 09 4F BC 56 8F E5 7A 72
	U 06:07:19	868.3	4/5	SF9BW125	5	26011600	17	40 00 16 01 26 00 05 00 07 F0 75 38 A0 AA 77 8E F3
	U 06:05:40	868.5	4/5	SF9BW125	4	26011600	17	40 00 16 01 26 00 04 00 07 A9 A4 99 01 72 2D C5 EF
	U 06:05:24	868.3	4/5	SF9BW125	3	26011600	17	40 00 16 01 26 00 03 00 07 F8 69 82 8A FF 95 46 54
	U 06:04:48	868.1	4/5	SF9BW125	2	26011600	17	40 00 16 01 26 00 02 00 07 97 A4 FD 03 67 91 C2 B5
	U 06:04:06	868.3	4/5	SF9BW125	8	26011600	17	40 00 16 01 26 00 08 00 07 8A DE 9D B0 49 59 A6 1A
	U 06:03:37	868.3	4/5	SF9BW125	7	26011600	17	40 00 16 01 26 00 07 00 07 09 4F BC 56 8F E5 7A 72
	U 06:03:10	868.3	4/5	SF9BW125	6	26011600	17	40 00 16 01 26 00 06 00 07 A8 8D F9 E8 4C BB F0 12
	U 06:02:57	868.3	4/5	SF9BW125	5	26011600	17	40 00 16 01 26 00 05 00 07 F0 75 38 A0 AA 77 8E F3
	U 06:02:22	868.3	4/5	SF9BW125	4	26011600	17	40 00 16 01 26 00 04 00 07 A9 A4 99 01 72 2D C5 EF
	U 05:47:40	868.1	4/5	SF9BW125	3	26011600	17	40 00 16 01 26 00 03 00 07 F8 69 82 8A FF 95 46 54
	U 05:47:33	868.3	4/5	SF9BW125	2	26011600	17	40 00 16 01 26 00 02 00 07 97 A4 FD 03 67 91 C2 B5
	U 05:47:01	868.1	4/5	SF9BW125	1	26011600	29	40 00 16 01 26 00 01 00 02 B3 9A A9 3C 63 44 27 C6 EE DE 51 DB 55 00 66 9A A2 DB 29 7F
	U 00:48:43	868.3	4/5	SF9BW125	1	2601197C	17	40 7C 19 01 26 00 01 00 01 40 C5 69 4B 6D 22 B1 DE
	U 00:03:32	868.1	4/5	SF9BW125	2	2601197C	29	40 7C 19 01 26 00 02 00 02 69 15 10 0B 82 6B 40 04 8A 12 49 8E C9 2A 50 C4 A9 85 74 4F
	U 00:03:24	868.1	4/5	SF9BW125	1	2601197C	29	40 7C 19 01 26 00 01 00 02 52 F1 3F 33 59 FE 1C 79 1A 02 9D 38 64 FF 54 B6 F4 61 24 22

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3. Configurations in the source code

3.1 Debug Log

By the default, the debug log from the gateway application can be forwarded to UDP port 50007, because all of the UART port was used for the TX and RX, and no extra UART port can be used for show debug log, a python script (named 'udp_receive.py') can be used for show the debug log from UDP port 50007. The file is located at the root path of WICED SDK as below:

`$(WICED_SDK_ROOT_PATH)\43xxx_Wi-Fi\libraries\lora_gateway\lib_log_tracer\udp_receive.py`

3.1.1 Change Debug UDP port

You can change the Debug UDP port by modify the source code at the line no. 112 (around) in the file below, or comment out this line for disable to forwarding log on the UDP port.

- ◆ `$(WICED_SDK_PATH)\43xxx_Wi-Fi\apps\snip\lora_lite_gw_pkt_fwd\lite_gw_pkt_fwd.c`

```

103 #endif
104
105 /* Disable roaming to other access points */
106 wiced_wifi_set_roam_trigger( -99 ); /* -99dBm ie. extremely
107
108 /* Bringup the network interface */
109 wiced_network_up( WICED_STA_INTERFACE, WICED_USE_EXTERNAL_D
110
111 /* enable to forward debug log on UDP port */
112 log_trace_enable_udp( WICED_STA_INTERFACE, 50007 );
113
114 /* not supported yet */
115 #if defined( LOCAL_GW_APPLICATIONS )
116 /* starting up the gateway portal on the device */
117 start_lite_gw_web();

```

Once you changed the UDP port, you must also change the UDP port in the python file below:

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```

1 import sys
2 import socket
3
4 address = ('', 50007)
5
6
7 s = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
8
9 s.bind(address)
10
11 while True:
12     data, addr = s.recvfrom(1024)
13     try:
14         sys.stdout.write(data.decode('utf-8'))
15     except:
16         print (" ")
17
18
19 s.close()

```

3.1.2 Enable Debug UART Port

By the default, the Debug UART port is disabled, if you want to enable it, the following three steps need to be completed.

1) Please open line no. 17 and comment out line no. 18 in the make file below:

◆ \$(WICED_SDK_PATH)\43xxx_Wi-Fi\apps\snip\lora_lite_gw_pkt_fwd\lora_lite_gw_pkt_fwd.mk

```

15
16
17 #GLOBAL_DEFINES      := USE_SELF_SIGNED_TLS_CERT
18 GLOBAL_DEFINES      := USE_SELF_SIGNED_TLS_CERT WICED_DISABLE_STDIO
19
20
21 VALID_PLATFORMS     := BCMUSI22
22

```

2) WICED SDK uses UART1 as the debug port, since UART1 is connected to RF chain 2, so we need to disable it by comment out the source code at line no. 92 in the file below:

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```

83 void application_start( void )
84 {
85     int nb_pkt;
86     struct lgw_pkt_tx_s txpkt; /* array containing
87
88     wiced_init( );
89
90     /* register RF chain (SM-42 modules) */
91     slgw_add_rf_chain( &receiver1_conf );
92     slgw_add_rf_chain( &receiver2_conf );
93     slgw_add_rf_chain( &receiver3_conf );
94     slgw_add_rf_chain( &transmitter_conf );
95
96     /* Configure the device */
97     wiced_configure_device( NULL );
98

```

- 3) Rebuild and download the application on WM-N-BM-22 with no_dct parameter.
make_lite_gw_pkt_fwd.bat download run no_dct

3.2 The configuration of transmitter and receivers

By the default, the lite Lora-gateway uses 3 SM-42 modules for RX function and uses 1 SM-42 module for TX function, the default configuration is compatible with EU868 band, the following shows the detail configuration on the TX and RX:

Function	Frequency (MHz)	LoraWAN Data Rate	Spreading Factor	Bandwidth	Code Rate	UART Port
RX1	868.1	DR3	SF9	125K	4/5	UART3
RX2	868.3	DR3	SF9	125K	4/5	UART1
RX3	868.5	DR3	SF9	125K	4/5	UART4
TX1	869.5	DR3	SF9	125K	4/5	UART2

The corresponding configuration for the TX and RX was defined in the source files below, they can be changed depended on the application requirements.

◆ \$(WICED_SDK_ROOT_PATH)\43xxx_Wi-Fi\apps\snip\lora_lite_gw_pkt_fwd\rf_chain_conf.h

The configurations for RF frequency, UART connection and TX/RX assignment was defined in this file as below.

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```

/*
 * the RF receiver configuration for 868.3Mhz
 * you can override the configuration by follow the examples in the previous 'lrm_conf_t receiver1_conf'
 */
static lrm_conf_t receiver2_conf = {

    /* console configuration (use for AT-CMD communications)*/
    .cmd_console = {
        .if_conf = {
            .port_id = (int)WICED_UART_1, /* the UART port connected to the receiver (SM-42) */
        },
    },

    /* general RF chain configuration */
    .rf_conf = {
        .enable = 1,
        .freq_hz = 868300000, // the frequency that we want the module listens
        .rssi_offset = 0,
        .tx_enable = 0, // use the module as a receiver
    },

    .sync_gpio = -1, // no need to sync the TX/RX timing at this moment. */
};

```

◆ \$(WICED_SDK_ROOT_PATH)\43xxx_Wi-Fi\libraries\lora_gateway\include\lrm_lib.h

The configurations for RF data rate, code rate, bandwidth and output power for TX and RX was defined in this file as below.

```

/* the default module configuration for the gateway receivers */
#if 0

#define DEFAULT_RECEIVER_OP_MODE    LRM_RX_MODE /* the modem's operation mode */
#define DEFAULT_RECEIVER_DR        (DR3 << 24) | (LRM_SF_9 << 16) | (LRM_BW_125K << 8) | LRM_CR_4_5 /* sin
#define DEFAULT_RECEIVER_POWER    20 /* it is the TX power if used to transmit data */
#define DEFAULT_RECEIVER_IQ_INVERTED 0 /* it is the TX power if used to transmit data */

#else

#define DEFAULT_RECEIVER_OP_MODE    LRM_FGW_MODE /* the modem's operation mode */
#define DEFAULT_RECEIVER_DR        (DR3 << 24) | (LRM_SF_9 << 16) | (LRM_BW_125K << 8) | LRM_CR_4_5
#define DEFAULT_RECEIVER_JOIN_TYPE 0 /* APB join mode */
#define DEFAULT_RECEIVER_CLASS    2 /* LoRaWAN class-C */
#define DEFAULT_RECEIVER_BAND    0 /* EU868 */
#define DEFAULT_RECEIVER_DC    0 /* disable ducty-cycle */
#define DEFAULT_RECEIVER_RX2DR    3 /* the data rate of RX2: DR3 (SF9, BW125) */
#define DEFAULT_RECEIVER_RX2DT    2000 /* the delay ms of rx2 window: 2000ms */
#define DEFAULT_RECEIVER_RX1DT    1000 /* the delay ms of rx1 window: 1000ms (used for join) */
#define DEFAULT_RECEIVER_POWER    20 /* it is the TX power for the TX RF chain */
#define DEFAULT_RECEIVER_IQ_INVERTED 1 /* LoRaWAN sends packet with inverted-iq */

#endif

/* the default module configuration for the gateway transmitters */
#define DEFAULT_TRANSMITTER_OP_MODE    LRM_WLAN_MODE /* the modem's operation mode */
#define DEFAULT_TRANSMITTER_DR        (DR3 << 24) | (LRM_SF_9 << 16) | (LRM_BW_125K << 8) | LRM_CR_4_5
#define DEFAULT_TRANSMITTER_JOIN_TYPE 0 /* APB join mode */
#define DEFAULT_TRANSMITTER_CLASS    2 /* LoRaWAN class-C */
#define DEFAULT_TRANSMITTER_BAND    0 /* EU868 */
#define DEFAULT_TRANSMITTER_DC    0 /* disable ducty-cycle */
#define DEFAULT_TRANSMITTER_RX2DR    3 /* the data rate of RX2: DR3 (SF9, BW125) */
#define DEFAULT_TRANSMITTER_RX2DT    2000 /* the delay ms of rx2 window: 2000ms */
#define DEFAULT_TRANSMITTER_RX1DT    1000 /* the delay ms of rx1 window: 1000ms (used for join) */
#define DEFAULT_TRANSMITTER_POWER    20 /* it is the TX power for the TX RF chain */
#define DEFAULT_TRANSMITTER_IQ_INVERTED 1 /* LoRaWAN sends packet with inverted-iq */

```

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4. Register gateway & application on TTN

The followings provides an example to register a virtual gateway and application on TTN.

1) In order to avoid collision with other gateway ID, please change the gateway ID defined in the file below, the new gateway ID will be used to registering a gateway on TTN:

◆ \$(WICED_SDK_ROOT_PATH)\43xxx_Wi-Fi\libraries\lora_gateway\lib_legacy_pkt_fwd\legacy_pkt_fwd.h

```

3  #define __LEGACY_PKT_FWD__
4
5  #include "loragw_hal.h"
6
7
8  #define THE_GATEWAY_ID "\xFF\xFE\x02\x0A\xF7\x58\x20\x9E"
9
10 int init_legacy_pkt_fwd( wiced_interface_t intf, char *host_i
11 wiced_result_t pull_legacy_pkt( struct lgw_pkt_tx_s *lrx_pkt
12 int request_pull_legacy_pkt( void );
13 int push_legacy_pkt( struct lgw_pkt_rx_s *p );
14
15

```

2) Sign up a TTN account then go to the gateway register webpage for register a gateway, and please fill the data by follow the red box below:

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Gateways > Register

REGISTER GATEWAY

Gateway EUI
The EUI of the gateway as read from the LoRa module

FF FE 02 0A F7 58 20 9E ✓ 8 bytes

☒ **I'm using the legacy packet forwarder**
Select this if you are using the legacy [Semtech packet forwarder](#).

Description
A human-readable description of the gateway

A Lite Lora-gateway ✓

Frequency Plan
The [frequency plan](#) this gateway will use

Europe 868MHz ↕

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Router

The router this gateway will connect to. To reduce latency, pick a router that is in a region which is close to the location of the router itself.

ttn-router-eu

Location

The exact location of you gateway. This will be used if your gateway cannot determine its location by itself. Set a location by clicking on the map.

+
-

lat23.92578896
lng120.66209683

Antenna Placement

The placement of the gateway antenna

indoor

outdoor

Cancel

Register Gateway

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3) Go to the application webpage for register an application, and please fill the data by follow the red box below:

Applications > Add Application

ADD APPLICATION

Application ID
The unique identifier of your application on the network

07

Description
A human readable description of your new app

My SM-42 network

Application EUI
An application EUI will be issued for The Things Network block for convenience, you can add your own in the application settings page.

EUI issued by The Things Network

Handler registration
Select the handler you want to register this application to

ttn-handler-eu


Cancel Add application

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4) Then we will go to the new application webpage as below, we need to set the application EUI (shown in the red box below) in the SM-42 module by the AT command below:

AT+APPEUI=70B3D57EF0005FE7

Applications >  07

[Overview](#)
[Devices](#)
[Payload Formats](#)
[Integrations](#)
[Data](#)
[Settings](#)

APPLICATION OVERVIEW

[documentation](#)

Application ID 07

Description My SM-42 network

Created 3 seconds ago

Handler ttn-handler-eu (current handler)

APPLICATION EUIs

[manage euis](#)

<>


⇌

70 B3 D5 7E F0 00 5F E7

📋

DEVICES

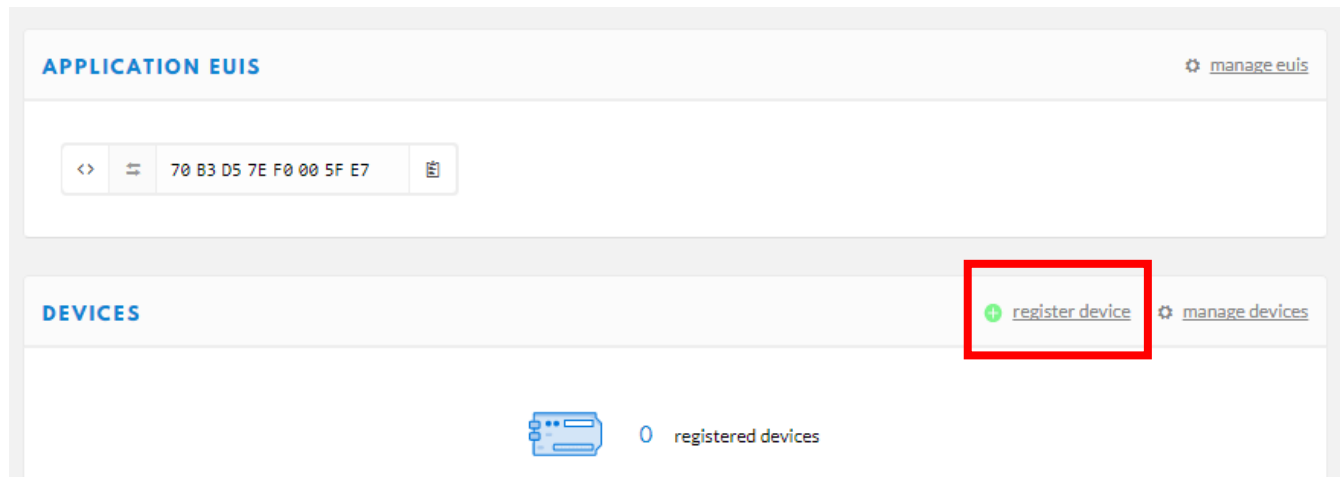
[+ register device](#)
[⚙ manage devices](#)

 0 registered devices

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4) After finish the application EUI setting, we need to join the SM-42 module in this application, please click the button 'register device' to starting the registration.



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4) Then a register device webpage appears, please also fill the data by follow the red box below, the device ID and device EUI in the SM-42 module can be queried by the command below:

AT+ADDR

AT+EUI

Applications > 07 > Devices

Overview Devices Payload Formats Integrations Data Settings

REGISTER DEVICE [bulk import devices](#)

Device ID
This is the unique identifier for the device in this app. The device ID will be immutable.

2601197c This is depended on the query result

Device EUI
The device EUI is the unique identifier for this device on the network. You can change the EUI later.

32 38 34 32 85 34 70 16 This is depended on the query result 8 bytes

App Key
The App Key will be used to secure the communication between you device and the network.

this field will be generated

App EUI

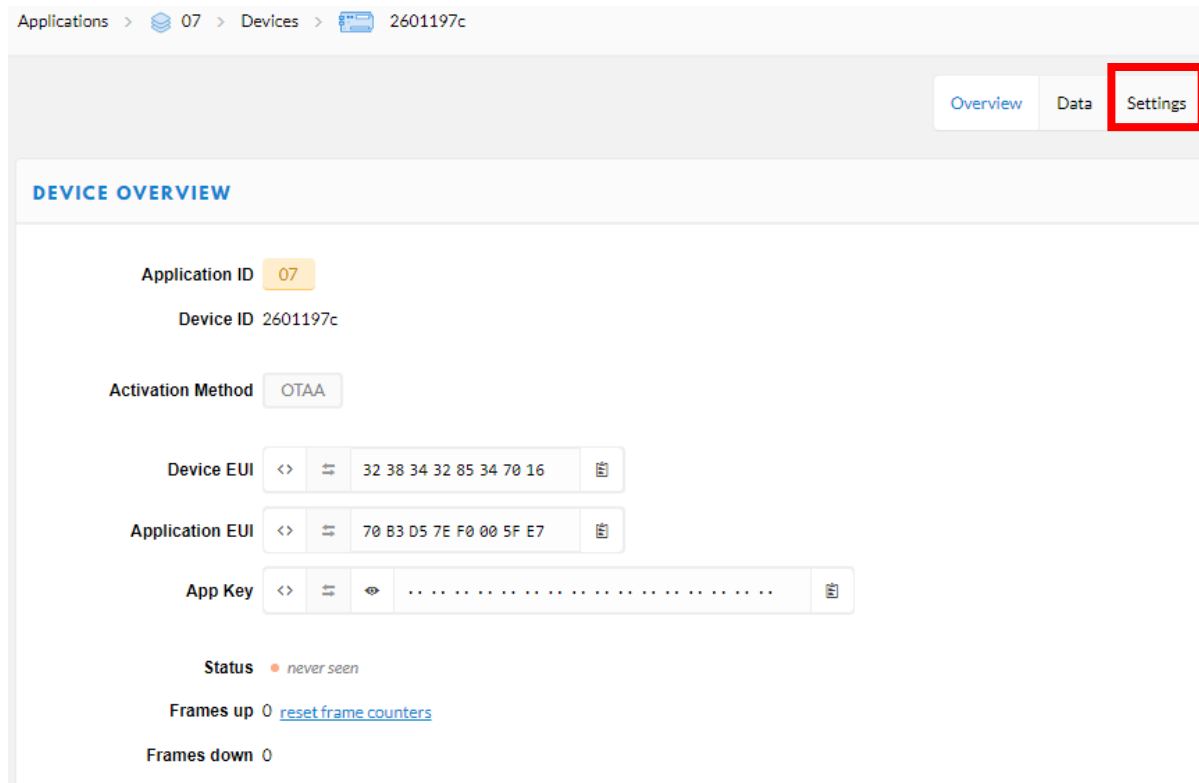
70 B3 D5 7E F0 00 5F E7

Cancel Register

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5) After finish the device registration then we will go to the new device webpage, since the lite Lora-gateway only support the ABP activation protocol, please click the button 'Settings' to changing some settings.



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6) Please fill the settings by follow the red box below:

Device EUI
The serial number of your radio module, similar to a MAC address

32 38 34 32 85 34 70 16
8 bytes

Application EUI

70 B3D5 7E F0 00 5F E7

Activation Method

OTAA
ABP

Device Address

The device address will be assigned by the network server and is not customizable

Network Session Key

11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF 00
16 bytes

App Session Key

11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF 00
16 bytes

Frame Counter Width

16 bit
32 bit

☒ **Frame Counter Checks**

Delete Device
Cancel
Save

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6) After finished the settings, we will back to the new device webpage, a new device address was generated on this webpage, and we must set it in the SM-42 module by the command below:

AT+ADDR=26011600

Applications > 07 > Devices > 2601197c

Activation Method ABP

Device EUI

<> 32 38 34 32 85 34 70 16

Application EUI

<> 70 B3 D5 7E F0 00 5F E7

Device Address

<> 26 01 16 00

Network Session Key

<>

App Session Key

<>

Status never seen

Frames up 0 [reset frame counters](#)

Frames down 0