PG1301 LoRaWAN Concentrator User Manual

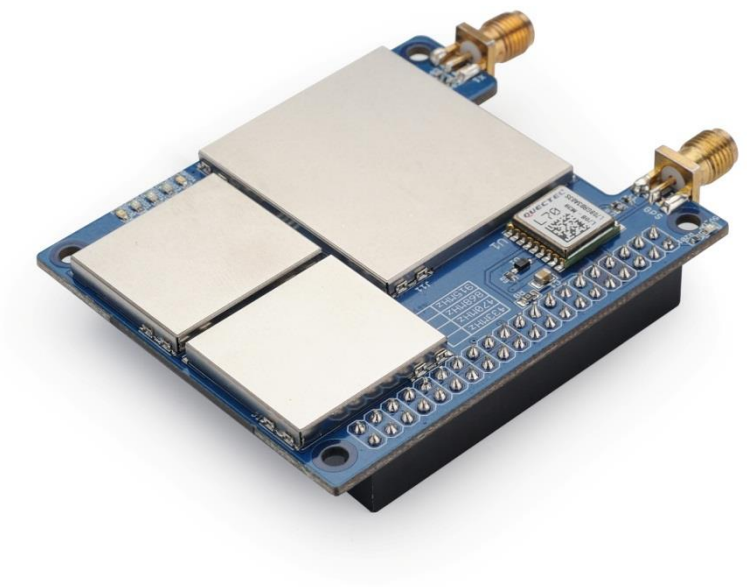
Document Version: 1.0.4

Image Version: v1.0

Version	Description	Date
1.0	Release	2019-Jun-24
1.0.1	Add FAQ for how to get lorapktfwd.deb	2019-Sep-5
1.0.2	Add SPI description	2019-Sep-23
1.0.3	Fix typo	2020-Mar-17
1.0.4	Add GPS info	2020-Apr-29
1.0.5	Add LED info	2021-Jan-5
1.0.6	Change LoRaWAN Server to use TTNv3	2022-Feb-5

1. Introduction

1.1 What is PG1301 LoRaWAN Concentrator?



The PG1301 is a multi-channel high performance transmitter/receiver designed to simultaneously receive several LoRa packets using random spreading factors on random channels. Its goal is to enable robust connection between a central wireless data concentrator and a massive amount of wireless end-points spread over a very wide range of distances.

The PG1301 is design to use with Raspberry Pi to build smart metering fixed networks and Internet of Things applications with up to 5000 nodes per km2 in moderately interfered environment.

PG1301 has built-in GPS module. The GPS module provide timing to SX1301 for accuracy timing and provide geographical coordinates to RPi for further process.

1.2 Features

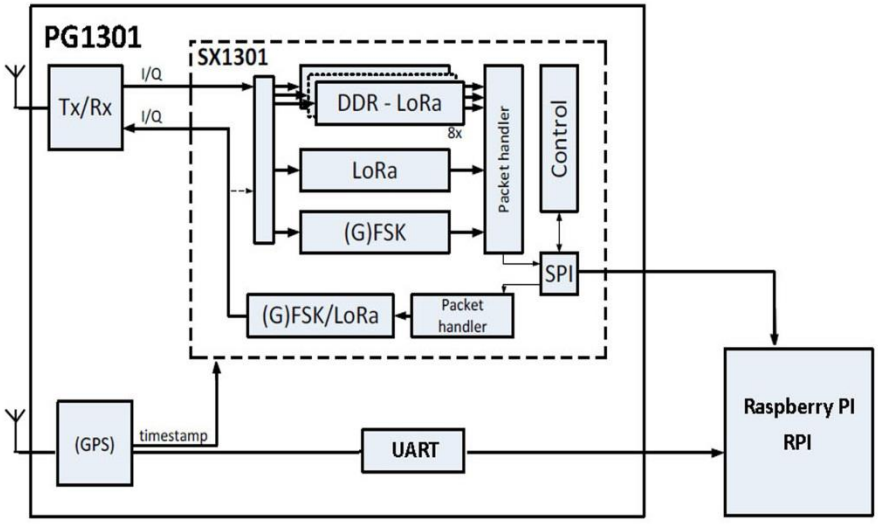
- ✓ Support Raspberry Pi 3B/3B+/4
- ✓ Up to -142.5dBm sensitivity with SX1257 Tx/Rx front-end (see reference design)
- ✓ 70 dB CW interferer rejection at 1 MHz offset
- ✓ Able to operate with negative SNR, CCR up to 9dB
- ✓ Emulates 49x LoRa demodulators and 1x (G)FSK demodulator

- ✓ Dual digital TX&RX radio front-end interfaces
- ✓ 10 programmable parallel demodulation paths
- ✓ Dynamic data-rate (DDR) adaptation

1.3 General Interfaces

- ✓ SPI interface for LoRa
- ✓ Specifications:
- ✓ Power Input: 5v, 1A
- ✓ 1 x SMA antenna for LoRa
- ✓ 1 x SMA antenna for GPS

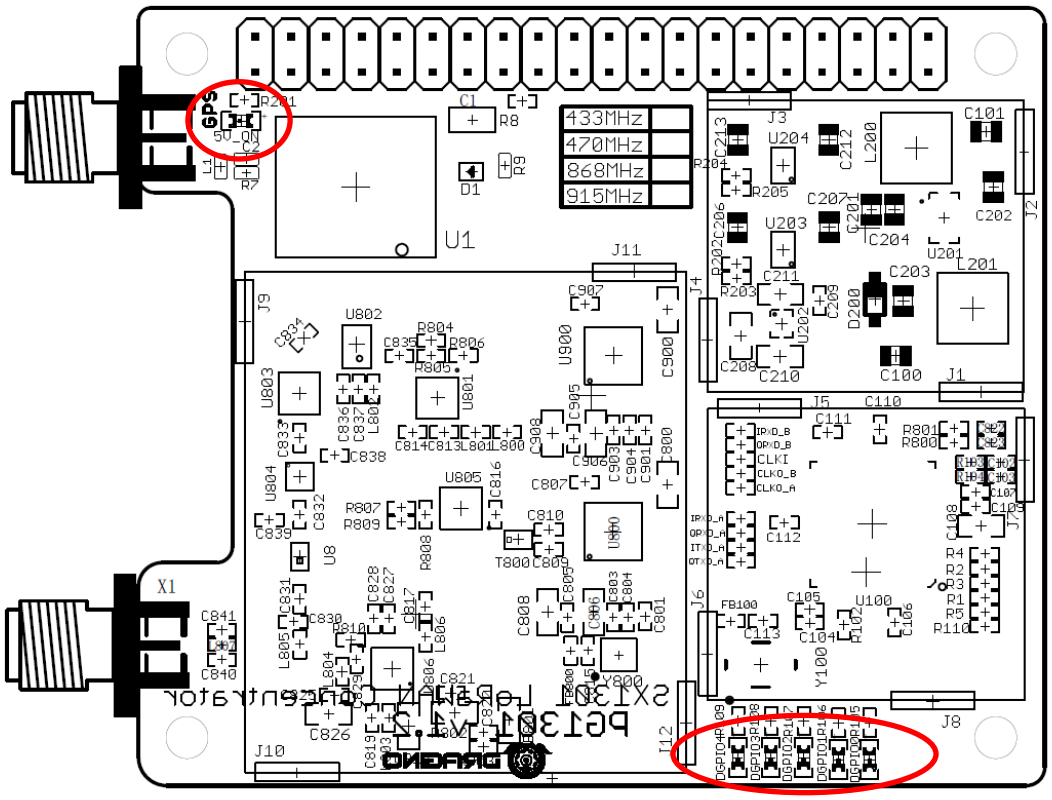
1.4 System Structure



1.5 Pin Mapping

Pin No	Raspberry Pi BCM pin number	PG1301 Definition
2	**5V**	**5V**
4	**5V**	**5V**
6	**GND**	**GND**
8	**UART_TX**	**GPS_RX**
9	**GND**	**GND**
10	**UART_RX**	**GPS_TX**
12	**PPS**	**GPS_PPS**
14	**GND**	**GND**
16	**GPIO23**	**LoRa_RESET**
19	**GPIO10**	**LoRa_MOSI**
20	**GND**	**GND**
21	**GPIO9**	**LoRa_MISO**
23	**GPIO11**	**LoRa_SCK**
24	**GPIO8**	**LoRa_CSN**
25	**GND**	**GND**
30	**GND**	**GND**
34	**GND**	**GND**
39	**GND**	**GND**

1.6 LEDs



- 5V_ON: Always on after plug into RPI.
- GPIO0: to SX1301 GPIO[0] : No function.
- GPIO1: to SX1301 GPIO[1] : No function.
- GPIO2: to SX1301 GPIO[2] : No function.
- GPIO3: to SX1301 GPIO[3] : No function.
- GPIO4: to SX1301 GPIO[4] : Indicate tx on

1.7 Power Consumption

TBD

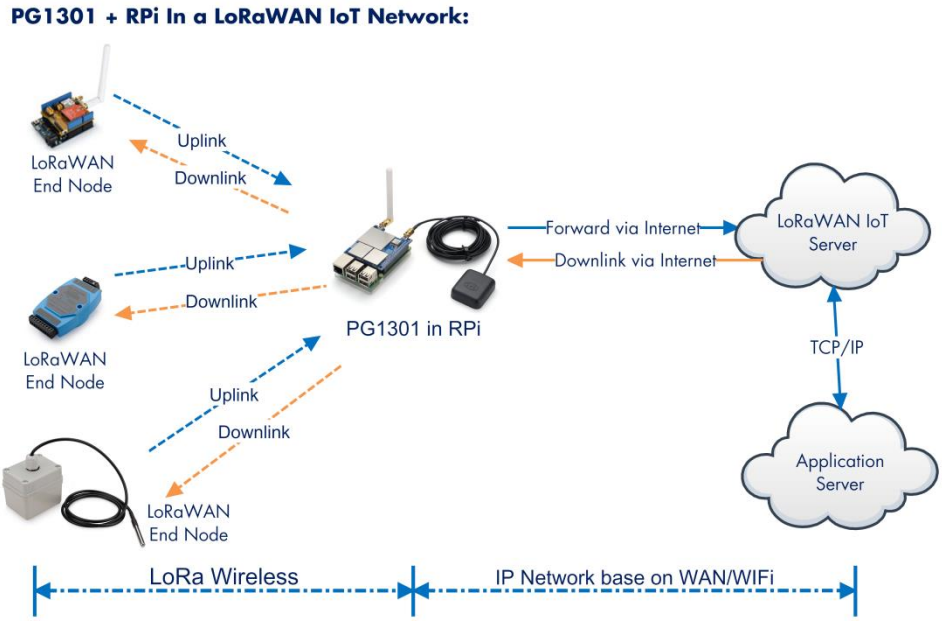
1.8 Applications

- ✓ Smart Buildings & Home Automation
- ✓ Logistics and Supply Chain Management
- ✓ Smart Metering
- ✓ Smart Agriculture
- ✓ Smart Cities
- ✓ Smart Factory

2. Example: Set up as LoRaWAN gateway.

2.1 System structure

This example is an example to show how to set up the PG1301 + RPi as a LoRaWAN gateway to use with TheThingsNetwork(TTN) LoRaWAN server.. Set up method for other server are similar



2.2 Hardware Installation

Important Notice: Please power the RPI with 5V,2A cable.

RPI in this example is RPI model 3B with fresh Raspbian OS install.

```
pi@raspberrypi:~$ cat /etc/os-release
PRETTY_NAME="Raspbian GNU/Linux 8 (jessie)"
NAME="Raspbian GNU/Linux"
VERSION_ID="8"
VERSION="8 (jessie)"
ID=raspbian
ID_LIKE=debian
HOME_URL="http://www.raspbian.org/"
SUPPORT_URL="http://www.raspbian.org/RaspbianForums"
BUG_REPORT_URL="http://www.raspbian.org/RaspbianBugs"
```

2.3 Install the software?

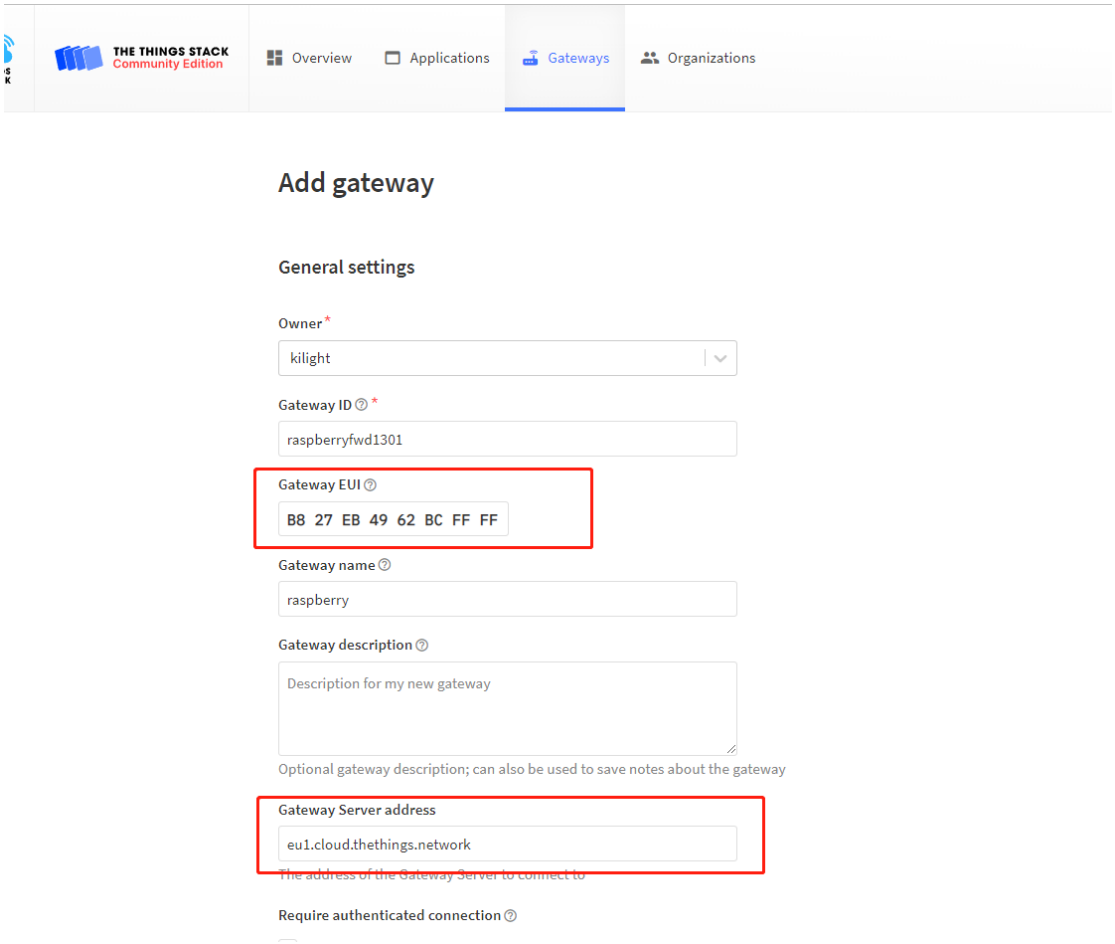
2.3.1 Get Gateway ID in Raspberry and input this in TTN v3.

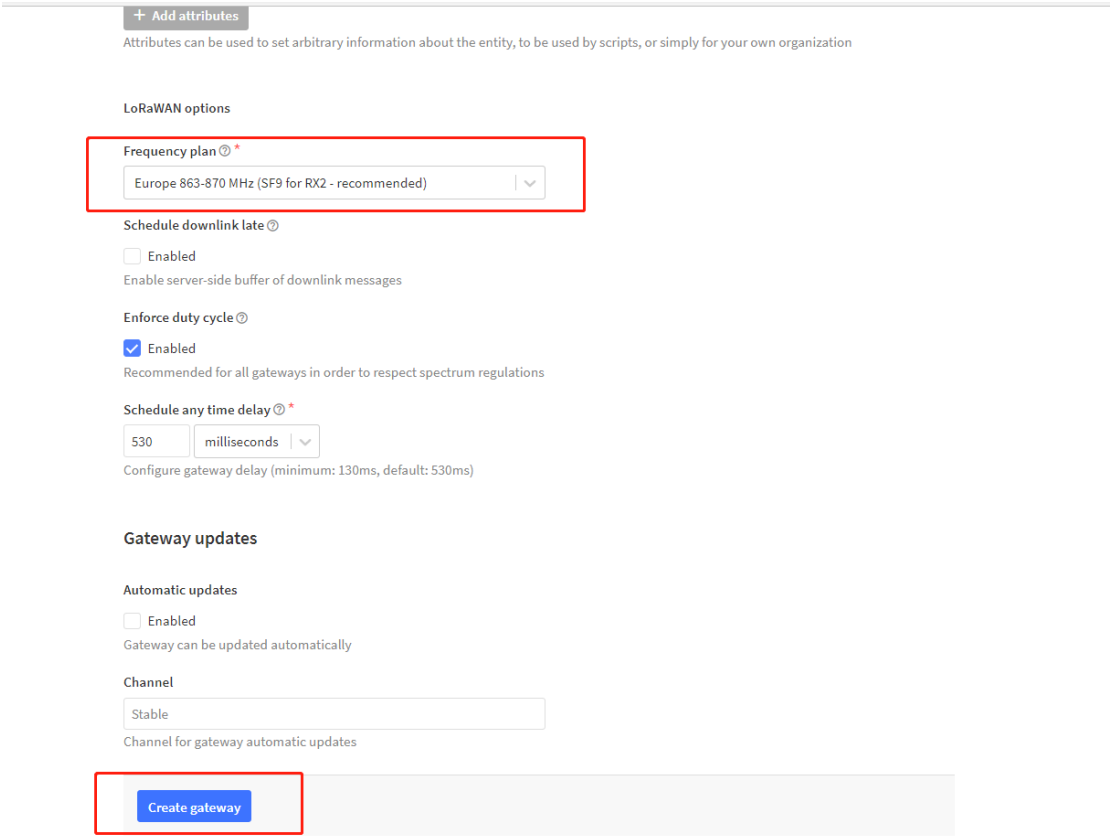
In RPI, run below command to get a Gateway ID

```
ifconfig eth0
```

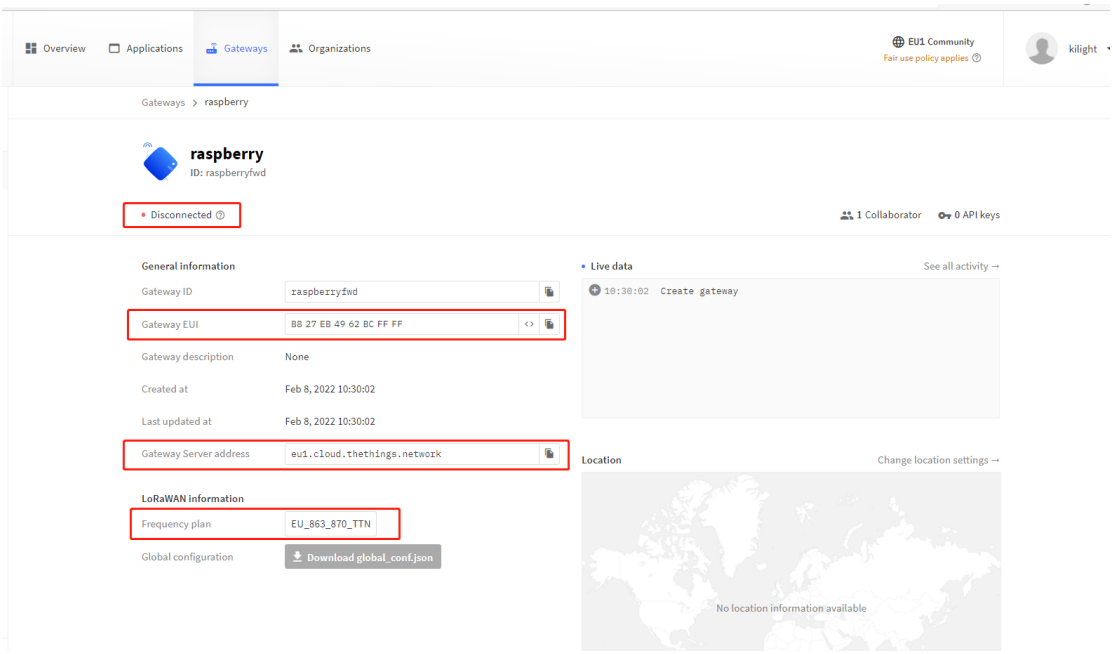
```
pi@raspberrypi:~/pi_gateway_fwd$ ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.130.2.56  netmask 255.255.255.0  broadcast 10.130.2.255
        inet6 fe80::73a9:f7ec:7662:1b21  prefixlen 64  scopeid 0x20<link>
        ether b8:27:eb:49:62:bc  txqueuelen 1000  (Ethernet)
        RX packets 275633  bytes 351399638 (335.1 MiB)
        RX errors 0  dropped 179  overruns 0  frame 0
        TX packets 140253  bytes 11036711 (10.5 MiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

We got the ether (eth0 MAC) address is b8:27:eb:49:62:bc). Add ffff at the end and remove ":" to get the gateway ID: b827ebxxxxbcffff. Input this to TTN v3. Make sure to select legacy packet forwarder.





After set up, the status should show not connected as below:

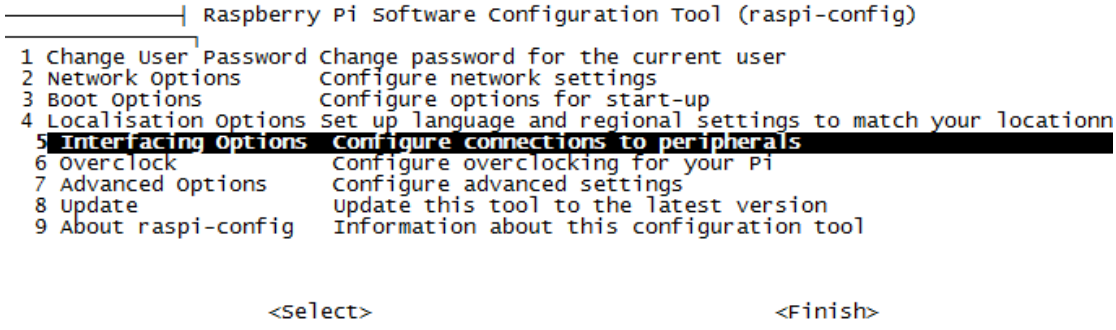


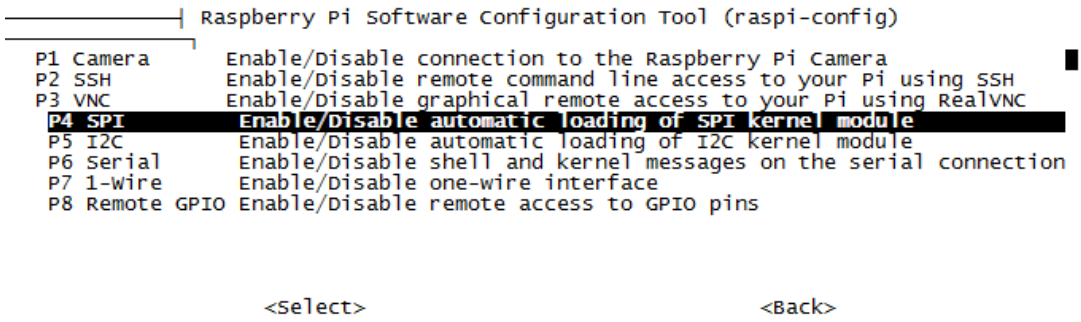
2.3.2 Download and install LoRaWAN packet forwarder

Enable SPi first:

a) SPI needs to be enabled on the Raspberry Pi

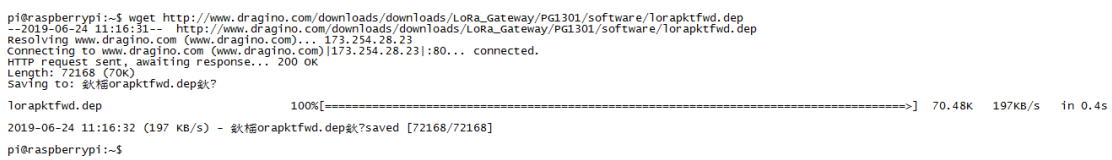
Run sudo raspi-config to open the config window





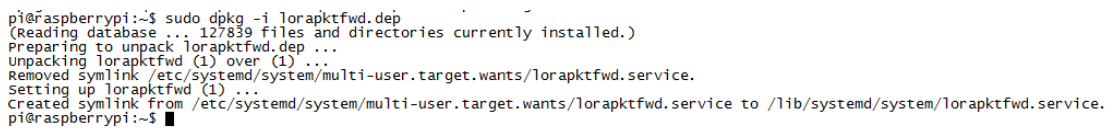
In RPI , run:

wget http://www.dragino.com/downloads/downloads/LoRa_Gateway/PG1301/software/lorapktfwd.deb



This will download the packet forwarder package from Dragino Server to RPI.

run “sudo dpkg -i lorapktfwd.deb” to install pkt fwd, pktfwd will auto run after this command. But the TTN will still show not connected because the Gateway ID doesn’t match.



2.3.3 Config Gateway ID, Frequency Band and Server address

After installation, user can find the configuration file in **/etc/lora-gateway.** Replace the gateway ID we got above to the **gateway_ID** in file **local_conf.json**

The default frequency band is EU868 in **global_conf.json** file and the default LoRaWAN server points to localhost, user need to put the correct server address to the server_address field, like below.

```
    "gateway_conf": {
        "gateway_ID": "B827EB4962BCFFFF",
        "server_address": "eu1.cloud.thethings.network",
        "serv_port_up": 1700,
        "serv_port_down": 1700,
        "keepalive_interval": 10,
        "stat_interval": 30,
        "push_timeout_ms": 100,
        "forward_crc_valid": true,
        "forward_crc_error": false,
        "forward_crc_disabled": false,
        "gps_tty_path": "/dev/ttyS0",
        "beacon_period": 128,
        "beacon_freq_hz": 869525000,
        "beacon_datarate": 9,
        "beacon_bw_hz": 125000,
        "beacon_power": 14,
        "beacon_infodesc": 0
    }
}
```

User can find the TTN v3 server address from:

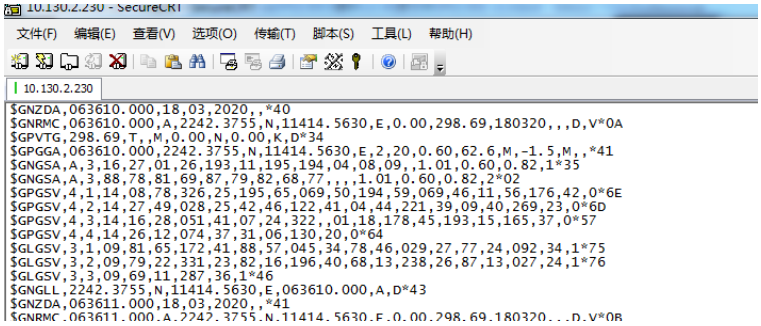
Server Addresses | The Things Stack for LoRaWAN (thethingsindustries.com)

- If user want to change to other frequency bands, User can copy the file from **/etc/lora-gateway/cfg** and rename it to **global_conf.json** and put it into **/etc/lora-gateway.**
- If user wants to change to other LoRaWAN server, modify the **global_conf.json** file.

2.3.4 Add GPS support

The PG1301 has a built-in GPS module, this module can provide GPS location info and PPS to uplink packets. There is no need to configure for PPS. For GPS location info, the GPS module use the RPi TXD(GPIO15) and RXD(GPIO16) pins. Make sure your RPi has configure these TXD/RXD pins are working as console. In RPi3, this UART interface is by default use for BLE, so you need to disable it and free it as console, (Please google to search related instruction).

Assume we have already set the RPI has valid console in /dev/ttyAMA0, we can use minicom to check the GPS info. (baud rate if 9600) and we can see below output in minicom.



After seeing this, exit minicom. And add /dev/ttyAMA0 to /etc/lora-gateway/global_conf.json

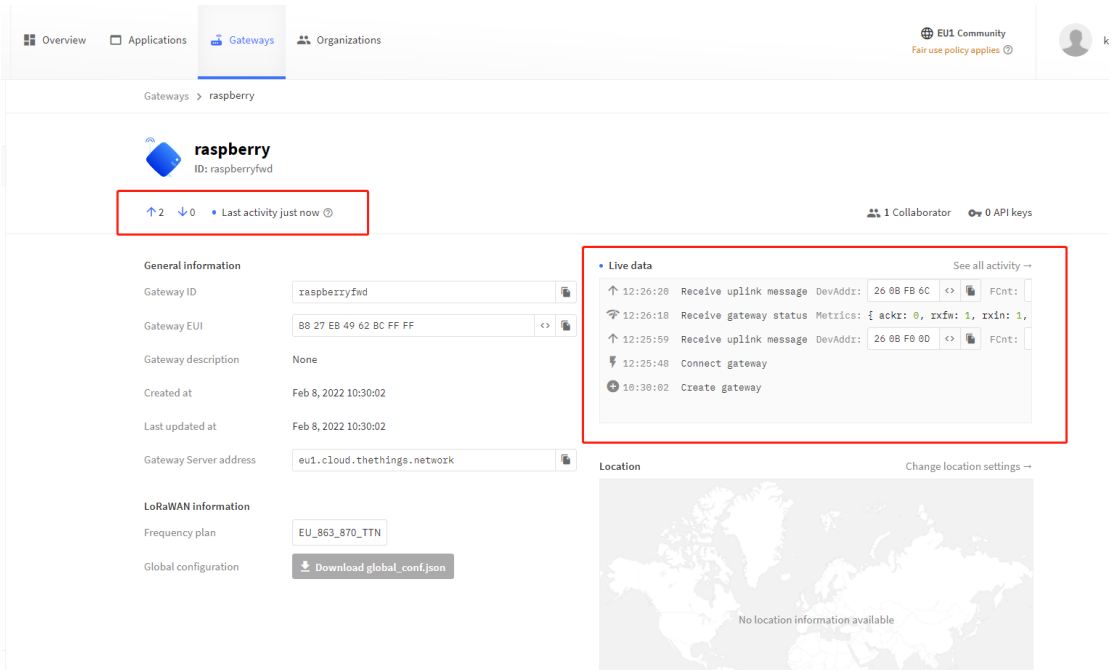
```
        "forward_crc_error": false,
        "forward_crc_disabled": false,
        "gps_tty_path": "/dev/ttyAMA0",      ---> Make sure this line use ttyAMA0
        "beacon_period": 128,
```

2.3.5 Check result

Run below command to restart the pkt_fwd:

```
sudo systemctl stop lorapktfwd
sudo systemctl start lorapktfwd
```

The pktfwd will start with the new gateway ID and TTN v3 should show the connection ok:

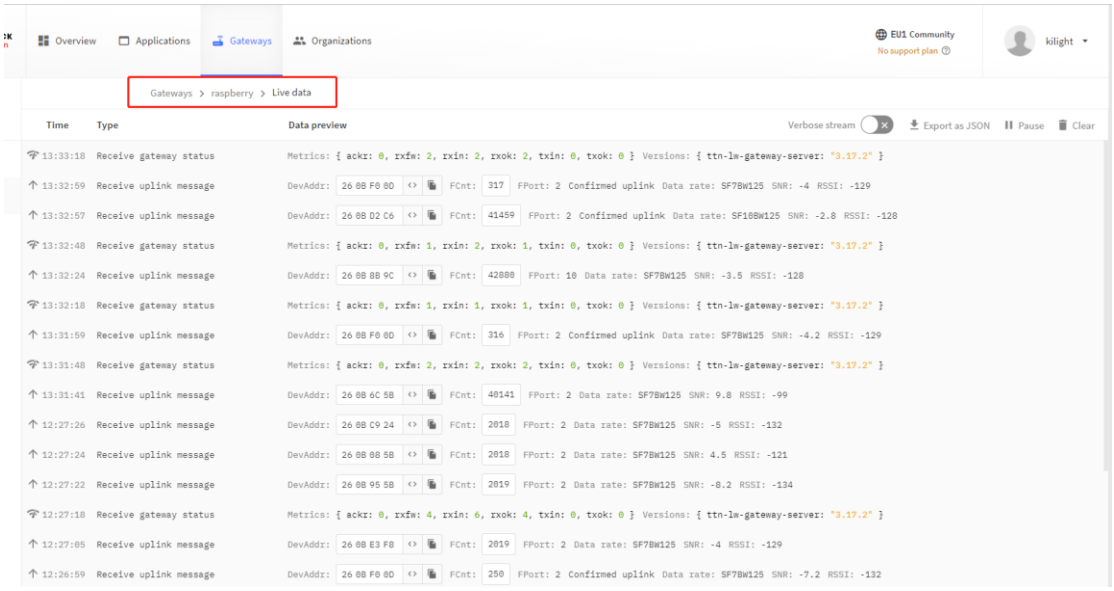


We can check pkt_fwd running states in RPi by running:

```
sudo journalctl -u lorapktfwd -f
```

```
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: ##### END #####
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: RXTX: {"stat":{"time":"2019-06-25 14:22:49 GMT","rxnb":2,"rxok":1,"rxfw":1,"ackr":0.0,"dwnb":0,"txnb":0}}
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: RXTX: {"rxpk":[{"tmst":1631340292,"chan":0,"rfch":1,"freq":868.100000,"stat":1,"modu":"LORA","datr":"SF12BW125","codr":"
4/5","lsnr":12.0,"rssi":-27,"size":24,"data":"QGSsuASaARwACkCPDOSRL3TkkFA1qtDlw"}]}
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: ################## Report at: 2019-06-25 14:23:19 GMT ##################
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: ### [UPSTREAM] ###
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # RF packets received by concentrator: 1
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # CRC_OK: 100.00%, CRC_FAIL: 0.00%, NO_CRC: 0.00%
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # RF packets forwarded: 1 (24 bytes)
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # PUSH_DATA datagrams sent: 2 (319 bytes)
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # PUSH_DATA acknowledged: 0.00%
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: ### [DOWNSTREAM] ###
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # PULL_DATA sent: 6 (50.00% acknowledged)
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # PULL_RESP(onse) datagrams received: 0 (0 bytes)
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # RF packets sent to concentrator: 0 (0 bytes)
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # TX errors: 0
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # TX rejected (collision packet): 0.00% (req:2, rej:0)
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # TX rejected (collision beacon): 0.00% (req:2, rej:0)
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # TX rejected (too late): 0.00% (req:2, rej:0)
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # TX rejected (too early): 0.00% (req:2, rej:0)
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # BEACON queued: 0
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # BEACON sent so far: 0
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: # BEACON rejected: 0
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: REPORT: ### [JIT] ###
Jun 25 14:23:19 raspberrypi lora_pkt_fwd[1373]: INFO: # SX1301 time (PPS): 1622469559
Jun 25 14:23:28 raspberrypi lora_pkt_fwd[1373]: sr1gw receive:1155: FIFO content: 1 32 1 5 18
```

If there are LoRaWAN nodes transmits nearby, we can see the traffic in TTN v3 –> Gateway --> Live data



2.3.6 Commands to handle service

- **Stop** lorapktfwd service: sudo systemctl stop lorapktfwd
- **Disable** lorapktfwd auto run after boot: sudo systemctl disable lorapktfwd
- **Start** lorapktfwd : sudo systemctl start lorapktfwd
- **Auto run** lorapktfwd after boot: sudo systemctl enable lorapktfwd
- **Show status** of lorapktfwd: sudo systemctl status lorapktfwd

3. Order Info

Part Number: **PG1301-XX**

- PG1301-868 (For Bands: EU868,IN865)
- PG1301-915 (For Bands: US915,AU915,AS923,KR920)
- PG1301-470 (For Band: CN470)

4. Packing Info

Package Includes:

- ✓ PG1301 x 1
- ✓ LoRa Antenna x 1
- ✓ GPS antenna x 1

Dimension and weight:

- ✓ Device Size: cm
- ✓ Device Weight:
- ✓ Package Size / pcs : cm
- ✓ Weight / pcs :

5. FAQ

5.1 How to compile the pkt-fwd for RPi?

Step 1: Update Raspian to the latest one.

sudo apt-get update

sudo apt-get upgrade

Step 2: Get source code:

git clone https://github.com/dragino/pi_gateway_fwd.git

Step3: Enter into pi_gateway_fwd and run

make && make deb

Then you will get the lorapktfwd.deb

6. Reference

- ✧ Datasheet, User Manual & Software Download:

http://www.dragino.com/downloads/downloads/LoRa_Gateway/PG1301/

7. Support

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

support@dragino.com