



LG308 LoRaWAN Gateway User Manual

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1.0	Release	2018-Nov-17

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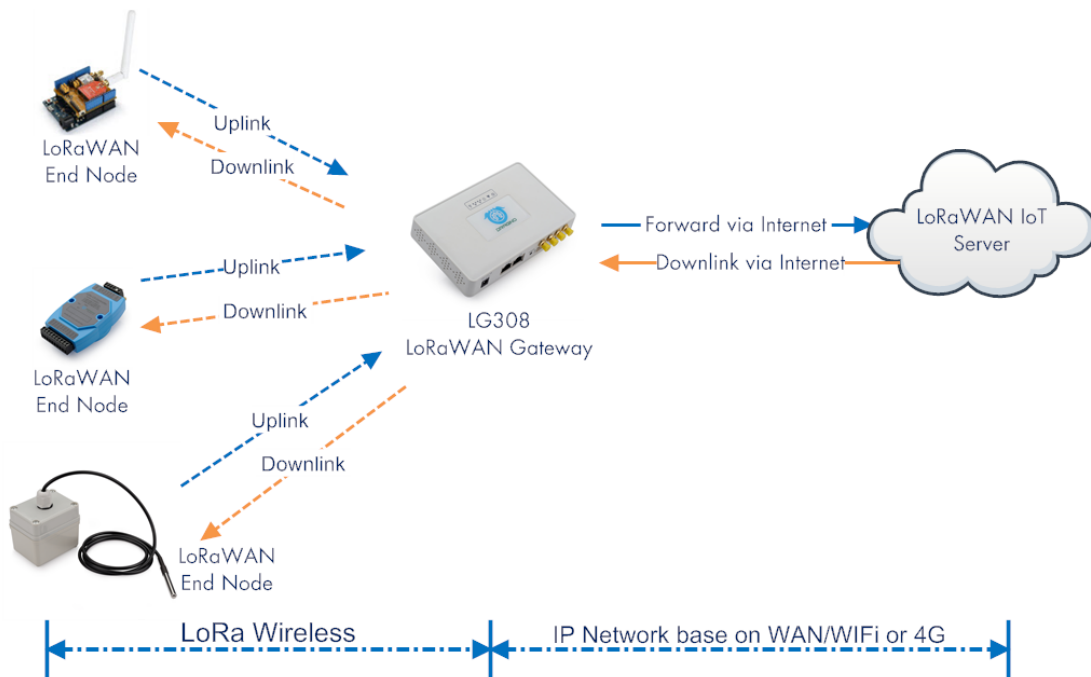
1. Introduction

1.1 What is LG08 & LG308

The LG308 is an open source **LoRaWAN Pico Gateway**. It lets you bridge LoRa wireless network to an IP network via WiFi, Ethernet, 3G or 4G cellular network. The LoRa wireless allows users to send data and reach extremely long ranges at low data-rates.

The LG308 is fully compatible with LoRaWAN protocol. It includes a SX1308 LoRa concentrator and a SX1276 LoRa transceiver, the **sx1308 provides 10 programmable parallel demodulation paths** and the **SX1276 acts as TX channel** so the SX1308 won't be block during TX. This combination provides higher capacity compare with a standalone SX1308 concentrator solution.

LG308 In a LoRaWAN IoT Network:



1.2 Specifications

Hardware System:

Linux Part:

- 400Mhz ar9331 processor
- 64MB RAM
- 16MB Flash

Interface:

- 10M/100M RJ45 Ports x 2
- WiFi : 802.11 b/g/n
- LoRaWAN Wireless

- Power Input: 12V DC, 1 A
- USB 2.0 host connector x 1
- Mini-PCI E connector x 1
- SX1308 + SX1276

WiFi Spec:

- IEEE 802.11 b/g/n
- Frequency Band: 2.4 ~ 2.462GHz
- Tx power:
 - ✓ 11n tx power : mcs7/15: 11db mcs0 : 17db
 - ✓ 11b tx power: 18db
 - ✓ 11g 54M tx power: 12db
 - ✓ 11g 6M tx power: 18db
- Wifi Sensitivity
 - ✓ 11g 54M : -71dbm
 - ✓ 11n 20M : -67dbm

LoRa Spec:

- Up to -142.5dBm sensitivity with SX1257 Tx/Rx front-end
- 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
- True antenna diversity or simultaneous dual-band operation

Cellular 4G LTE (optional):

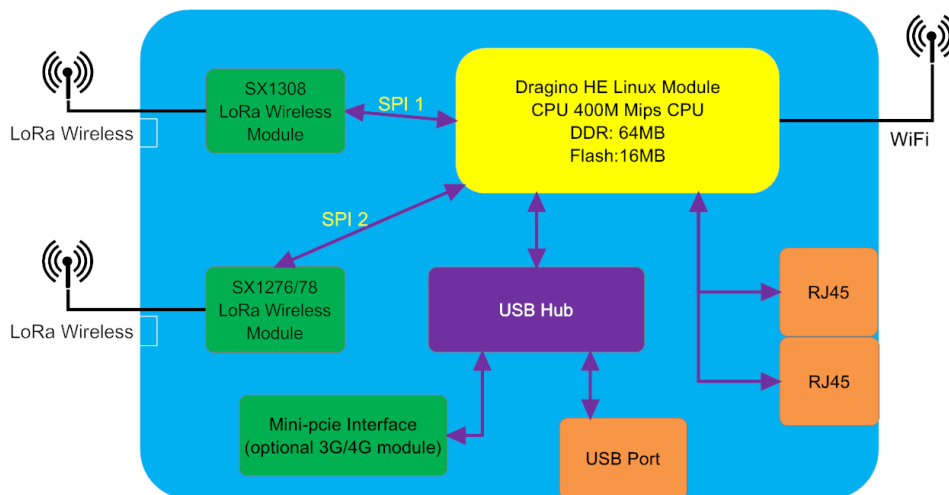
- Quectel [EC25 LTE module](#)
- Micro SIM Slot
- External 4G Sticker Antenna.
- Up to 150Mbps downlink and 50Mbps uplink data rates
- Worldwide LTE, UMTS/HSPA+ and GSM/GPRS/EDGE coverage
- MIMO technology meets demands for data rate and link reliability in modern wireless communication systems

1.3 Features

- ✓ Open Source OpenWrt system
- ✓ Managed by Web GUI, SSH via LAN or WiFi
- ✓ Emulates 49x LoRa demodulators
- ✓ LoRaWAN Gateway
- ✓ SX1276 base separate TX path
- ✓ 10 programmable parallel demodulation paths

1.4 Hardware System Structure

LG308 System Overview:



1.5 LG308 Applications



2. Access LG308

2.1 Access and configure LG308

The LG308 is configured as a WiFi AP by factory default. User can access and configure the LG308 after connect to its WiFi network.

At the first boot of LG308, it will auto generate an unsecure WiFi network call **dragino-xxxxxx**

User can use the laptop to connect to this WiFi network. The laptop will get an IP address 10.130.1.xxx and the LG308 has the default IP **10.130.1.1**



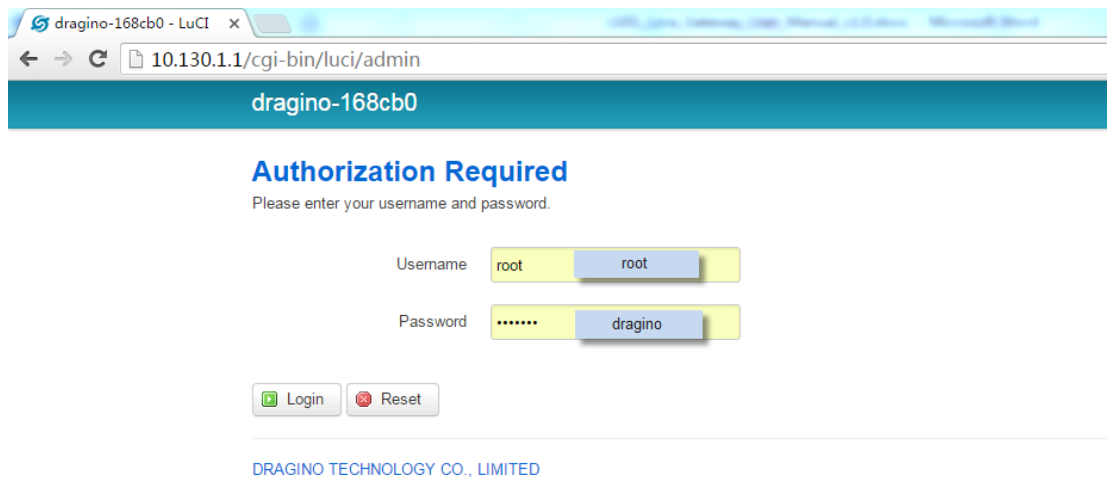
Open a browser in the laptop and type

<http://10.130.1.1/>

User will see the login interface of LG308.

The account for Web Login is:

User Name: root
Password: dragino



Notice: In case the WiFi network is disabled, user can connect PC to LG308's LAN port, the PC will get DHCP from LG308, and be able to access it.

3. Typical Network Setup

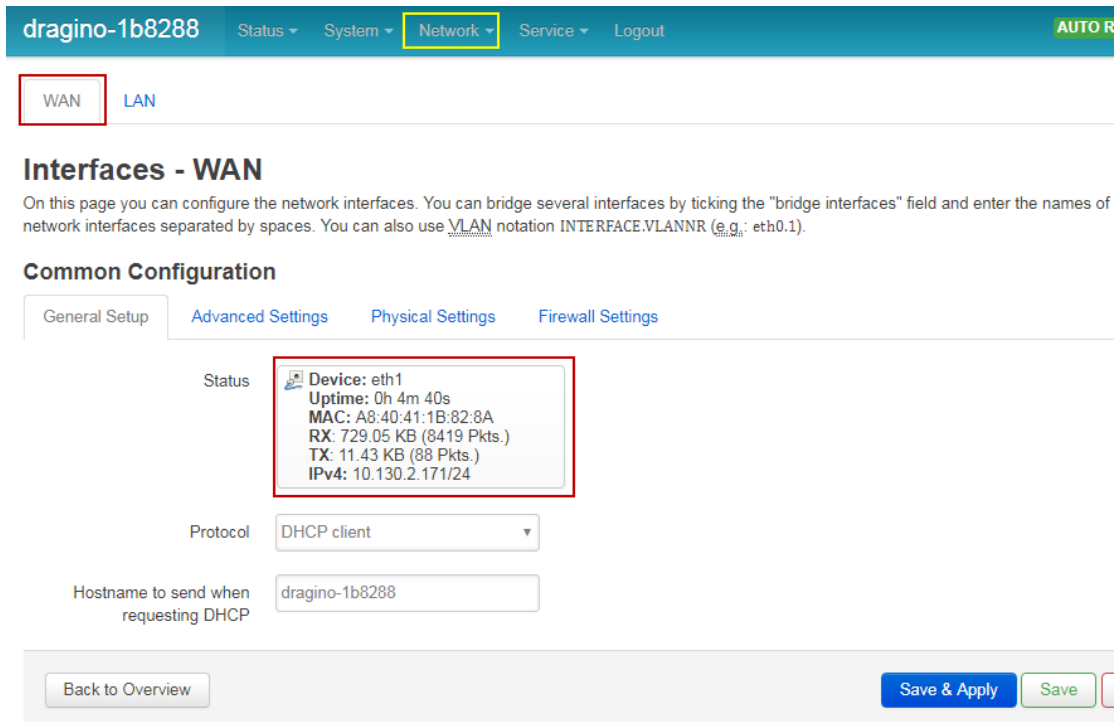
3.1 Overview

LG308 supports flexible network set up for different environment. This section describes the typical network topology can be set in LG308. The typical network set up includes:

- ✓ WAN Port Internet Mode
- ✓ WiFi Client Mode
- ✓ WiFi AP Mode
- ✓ USB Dial Up Mode

3.2 Use WAN port to access Internet

By default, the LG308 set to use WAN port as network connection. When connect LG308's WAN port to router, LG308 will get IP from router and have internet access. The network status can be checked as below:



dragino-1b8288 Status System **Network** Service Logout AUTO R

WAN LAN

Interfaces - WAN

On this page you can configure the network interfaces. You can bridge several interfaces by ticking the "bridge interfaces" field and enter the names of network interfaces separated by spaces. You can also use VLAN notation INTERFACE.VLANNR (e.g.: eth0.1).

Common Configuration

General Setup **Advanced Settings** Physical Settings Firewall Settings

Status Device: eth1
Uptime: 0h 4m 40s
MAC: A8:40:41:1B:82:8A
RX: 729.05 KB (8419 Pkts.)
TX: 11.43 KB (88 Pkts.)
IPv4: 10.130.2.171/24

Protocol DHCP client

Hostname to send when requesting DHCP dragino-1b8288

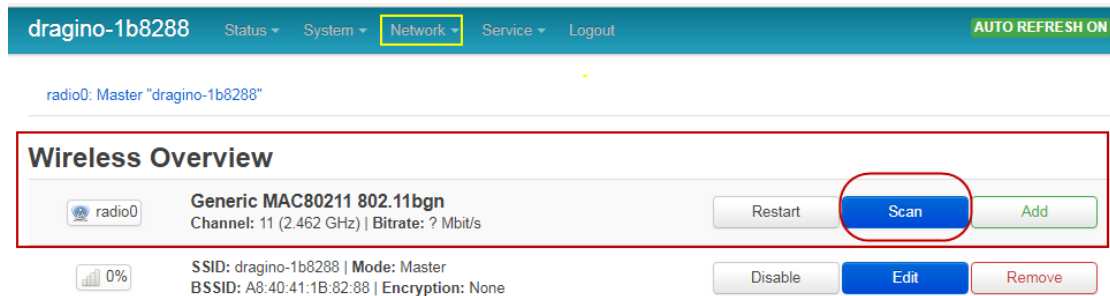
Back to Overview Save & Apply Save

3.3 Access Internet as a WiFi Client.

In the WiFi Client Mode, Dragino acts as a WiFi client and gets DHCP from uplink router via WiFi. The step to set is as below:

Step1:

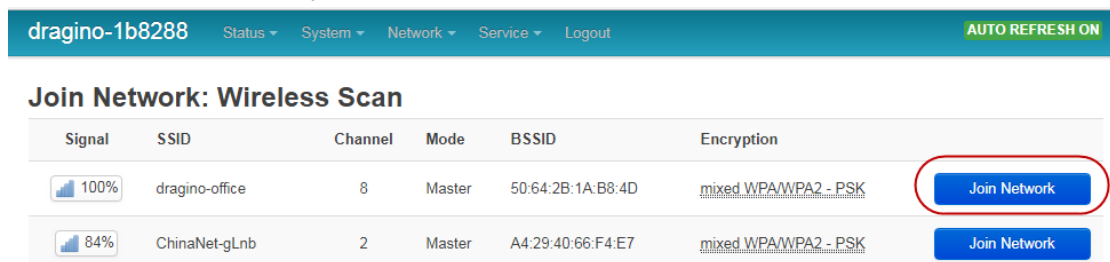
In network -> Wireless, select Radio0 interface and scan.



The screenshot shows the 'Wireless Overview' section for the 'radio0' interface. It displays the MAC address 'Generic MAC80211 802.11bgn', channel '11 (2.462 GHz)', and bitrate '? Mbit/s'. There are buttons for 'Restart', 'Scan' (circled in red), and 'Add'. Below this, it shows the SSID 'dragino-1b8288', Mode 'Master', BSSID 'A8:40:41:1B:82:88', and Encryption 'None'. There are also buttons for 'Disable', 'Edit', and 'Remove'.

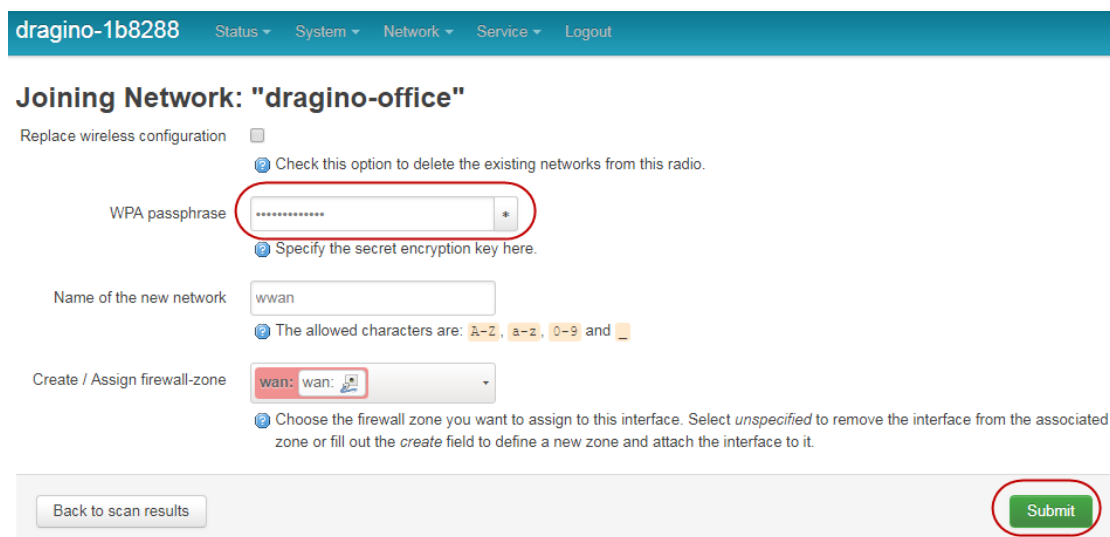
Step2:

Select the wireless AP and join:



The screenshot shows the 'Join Network: Wireless Scan' section. It contains a table with columns: Signal, SSID, Channel, Mode, BSSID, and Encryption. Two networks are listed: 'dragino-office' (100% signal) and 'ChinaNet-gLnb' (84% signal). The 'Join Network' button for 'dragino-office' is circled in red.

Signal	SSID	Channel	Mode	BSSID	Encryption	
100%	dragino-office	8	Master	50:64:2B:1A:B8:4D	mixed WPA/WPA2 - PSK	Join Network
84%	ChinaNet-gLnb	2	Master	A4:29:40:66:F4:E7	mixed WPA/WPA2 - PSK	Join Network



The screenshot shows the 'Joining Network: "dragino-office"' configuration page. It includes a checkbox for 'Replace wireless configuration' and a note to check this option to delete existing networks. The 'WPA passphrase' field is circled in red. Below it, there is a field for 'Name of the new network' (set to 'wwan') and a dropdown for 'Create / Assign firewall-zone' (set to 'wan: wan:'). A 'Submit' button is circled in red at the bottom right.

Step3:

In network->wireless page, disable WiFi AP network. Notice: After doing that, you will lose connection if your computer connects to the LG308 via LG308's wifi network.

radio0: Master "dragino-1b8288"

Wireless Overview

	Generic MAC80211 802.11bgn Channel: 11 (2.462 GHz) Bitrate: ? Mbit/s	Restart	Scan	Add
	SSID: dragino-1b8288 Mode: Master BSSID: A8:40:41:1B:82:88 Encryption: None	Disable	Edit	Remove
	SSID: dragino-office Mode: Client BSSID: 50:64:2B:1A:B8:4D Encryption: -	Disable	Edit	Remove

Associated Stations

Network	MAC-Address	Host	Signal / Noise	RX Rate / TX Rate
---------	-------------	------	----------------	-------------------

No information available

After successful associate, the WiFi network interface can be seen in the same page:

WAN WWAN LAN

Interfaces

	LAN br-lan	Protocol: Static address Uptime: 2h 0m 4s MAC: A8:40:41:1B:82:8B RX: 1.40 MB (13346 Pkts.) TX: 2.79 MB (10321 Pkts.) IPv4: 10.130.1.1/24	Restart	Stop	Edit	Delete
	WAN eth1	Protocol: DHCP client MAC: A8:40:41:1B:82:8A RX: 4.30 MB (51840 Pkts.) TX: 55.77 KB (429 Pkts.)	Restart	Stop	Edit	Delete
	WWAN Client "dragino-office"	Protocol: DHCP client Uptime: 0h 6m 6s MAC: A8:40:41:1B:82:88 RX: 549.38 KB (5659 Pkts.) TX: 14.90 KB (94 Pkts.) IPv4: 10.130.2.169/24	Restart	Stop	Edit	Delete

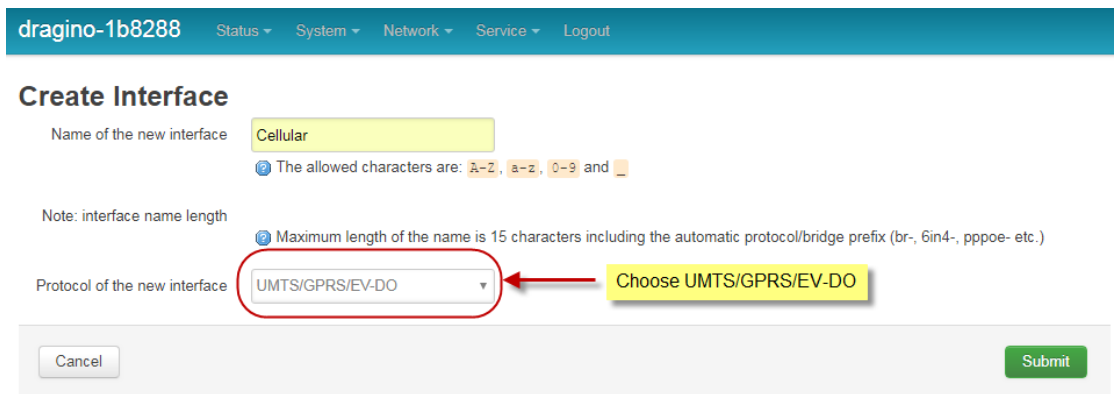
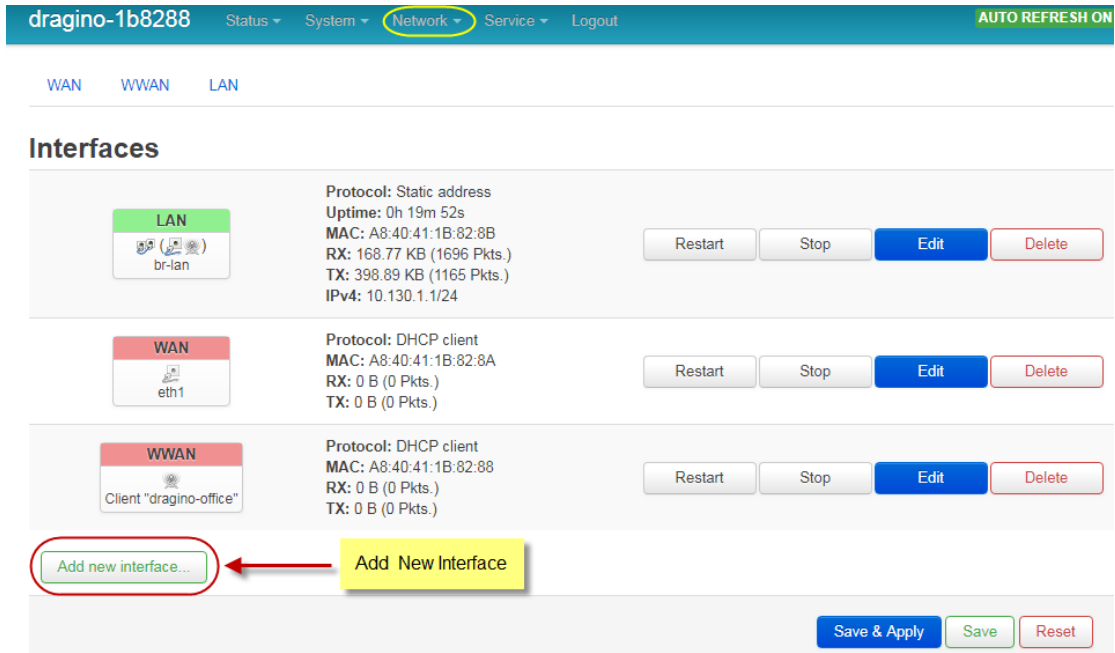
Add new interface...

Save & Apply Save Reset

3.4 Use built-in 4G modem for internet access

For the LG308 model with 4G version, user can configure the modem for internet access.

Step 1: Add New Interface



Step 2: Configure cellular interface

dragino-1b8288 Status System Network Service Logout **UNSAVED C**

Interfaces - CELLULAR

On this page you can configure the network interfaces. You can bridge several interfaces by ticking the "bridge interfaces" field and network interfaces separated by spaces. You can also use VLAN notation INTERFACE.VLANNR (e.g.: eth0.1).

Common Configuration

General Setup **Advanced Settings** Firewall Settings

Status Device: 3g-Cellular
RX: 0 B (0 Pkts.)
TX: 0 B (0 Pkts.)

Protocol UMTS/GPRS/EV-DO

Modem device /dev/ttyUSB2 **Use ttyUSB2 to dial up**

Service Type UMTS/GPRS

APN 3gnet **Different provider has different APN**

PIN

PAP/CHAP username

PAP/CHAP password **Some provider may need additional user info**

Dial number *99***1#

Step 3: Check Result

dragino-1b8288 Status System Network Service Logout **AUTO REFRESH ON**

WAN WWAN **CELLULAR** LAN

Interfaces

CELLULAR
3g-Cellular

Protocol: UMTS/GPRS/EV-DO
Uptime: 0h 0m 49s
MAC: 00:00:00:00:00:00
RX: 116 B (6 Pkts.)
TX: 680 B (16 Pkts.)
IPv4: 10.160.169.29/32 **Get IP from provider means dial up**

Restart Stop **Edit** Delete

Note: In case you don't know whether your device has 4G modem, you can run lsusb command in SSH access to check, as below:

```
10.130.1.1 - SecureCRT
文件(F) 编辑(E) 查看(V) 选项(O) 传输(T) 脚本(S) 工具(L) 帮助(H)
10.130.1.1
root@dragino-1b8288:~# lsusb
Bus 001 Device 003: ID 2c7c:0125
Bus 001 Device 002: ID 1a40:0101 Terminus Technology, Inc. Hub
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 USB
root@dragino-1b8288:~#
root@dragino-1b8288:~#
root@dragino-1b8288:~#
```

use lsusb command

This is the 4G modem

3.5 Check Internet connection

User can use the diagnostics page to check and analyze Internet connection.

dragino-1b8288 Status ▾ System ▾ **Network ▾** Service ▾ Logout

Diagnostics

Network Utilities

openwrt.org openwrt.org openwrt.org

IPv4 ▾ **Ping** **Traceroute** **Nslookup**

Install iputils-traceroute6 for IPv6 traceroute

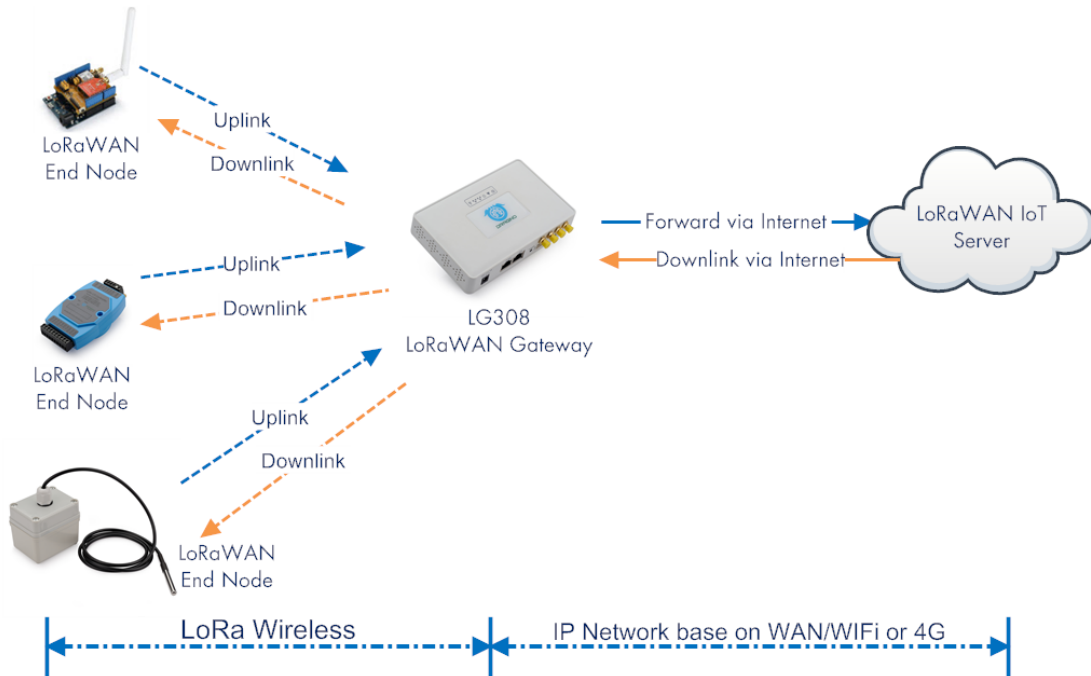
```
PING openwrt.org (139.59.209.225): 56 data bytes
64 bytes from 139.59.209.225: seq=0 ttl=45 time=386.898 ms
64 bytes from 139.59.209.225: seq=1 ttl=45 time=401.656 ms
64 bytes from 139.59.209.225: seq=2 ttl=45 time=387.708 ms
64 bytes from 139.59.209.225: seq=3 ttl=45 time=378.894 ms
64 bytes from 139.59.209.225: seq=4 ttl=45 time=384.156 ms

--- openwrt.org ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 378.894/387.862/401.656 ms
```

4. Example : Configure as a LoRaWAN gateway

LG308 is fully compatible with LoRaWAN protocol. It use the legacy Semtech Packet forwarder to forward the LoRaWAN packets to server, the structure is as below.

LG308 In a LoRaWAN IoT Network:

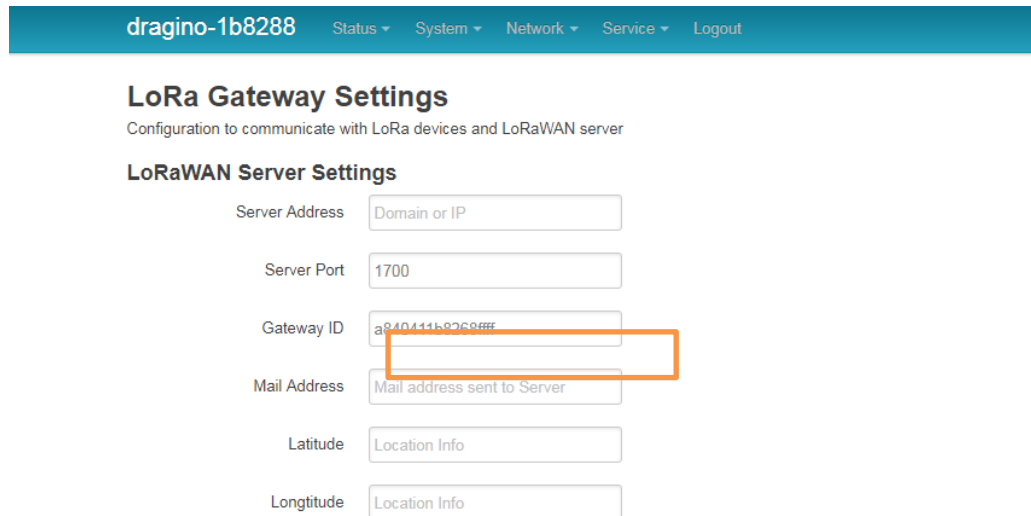


This chapter describes how to use LG308 to work with [TTN LoRaWAN Server](#). The method to work with other LoRaWAN server is similar.

4.1 Create a gateway in TTN Server

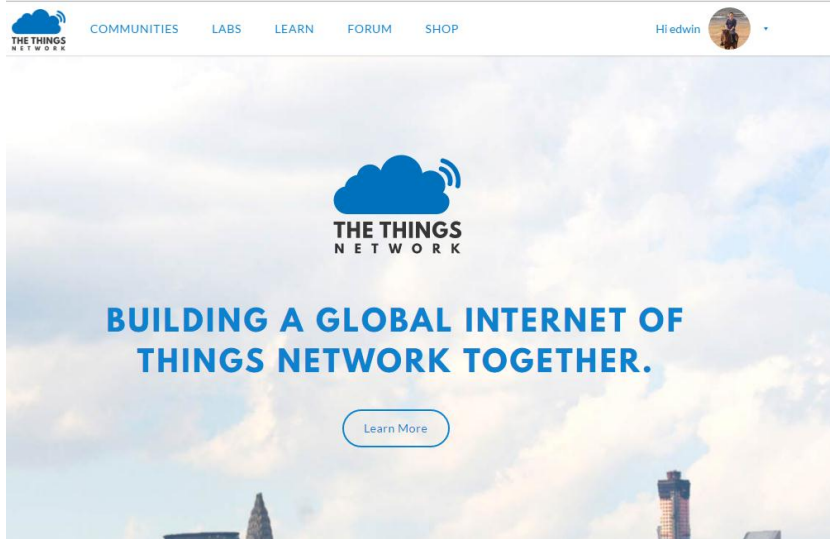
Step 1: Get a Unique gateway ID.

Every LG308 has a unique gateway id. The id can be found at LoRaWAN page:

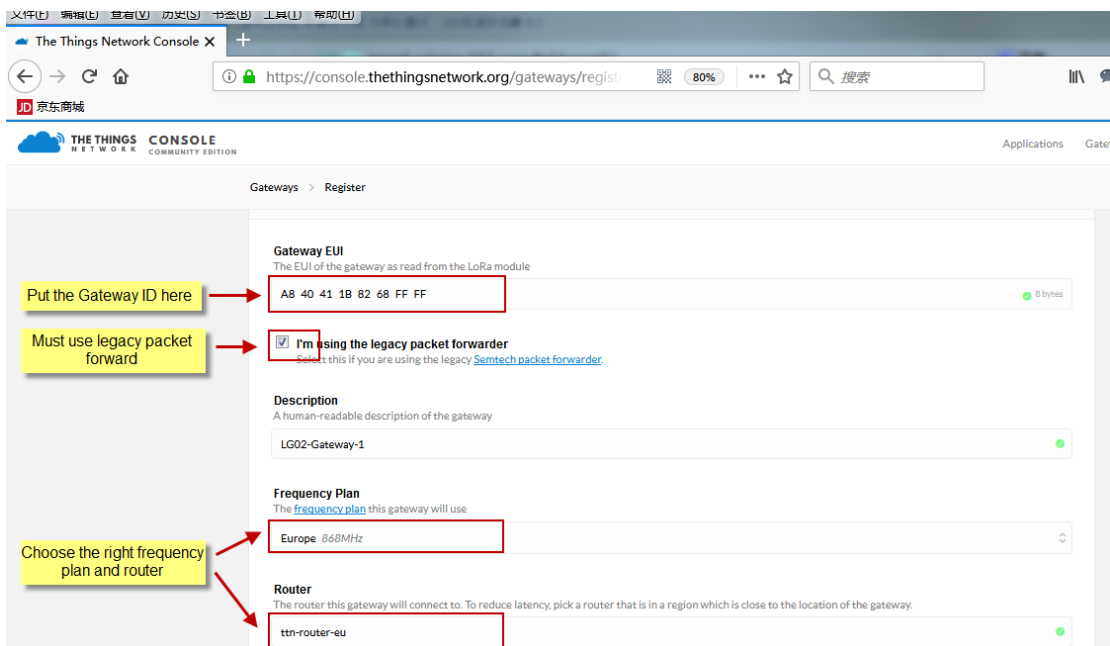
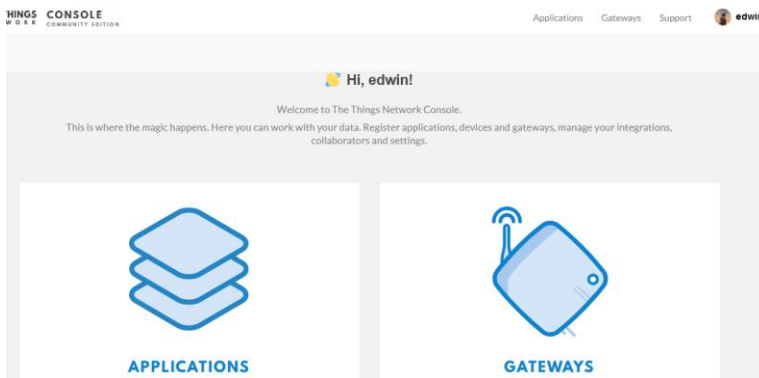


The gateway id is: **a840411b8268ffff**

Step 2: Sign up a user account in TTN server



Step 3: Create a Gateway



After create the gateway, we can see the gateway info, as below

GATEWAY OVERVIEW ⚙ settings

Gateway ID: eui-a840411b8268ffff

Description: Gateway-1

Owner: edwin [Transfer ownership](#)

Status: not connected

Frequency Plan: Europe 868MHz

Router: ttn-router-eu

Gateway Key: [masked] base64

4.2 Configure LG308 to connect to TTN

We should configure the LG308 now to let it connect to TTN network. Make sure your LG308 has Internet Connection first.

Step1: Configure LG308 to act as raw forwarder

dragino-1b8288 Status ▾ System ▾ Network ▾ Service ▾ Logout

IoT Service

IoT Service: Lorawan/RAW forwarder

Debug Level: No debug

[Save & Apply](#) [Save](#) [Reset](#)

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Step2: Input server info and gateway id

Choose the correct the server address and gateway ID.

dragino-1b8288 Status ▾ System ▾ Network ▾ Service ▾ Logout

LoRa Gateway Settings

Configuration to communicate with LoRa devices and LoRaWAN server

LoRaWAN Server Settings

Service Provider: The Things Network

Server Address: ttn-router-eu

Server Port: 1700

Gateway ID: a840411b8268ffff

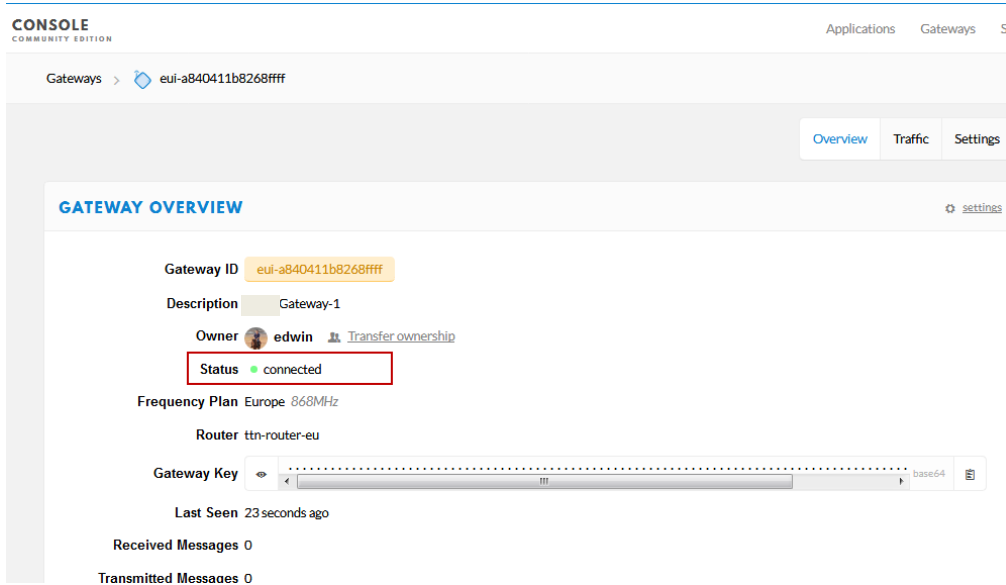
Mail Address: edwin@dragino.com

Latitude: 22.73

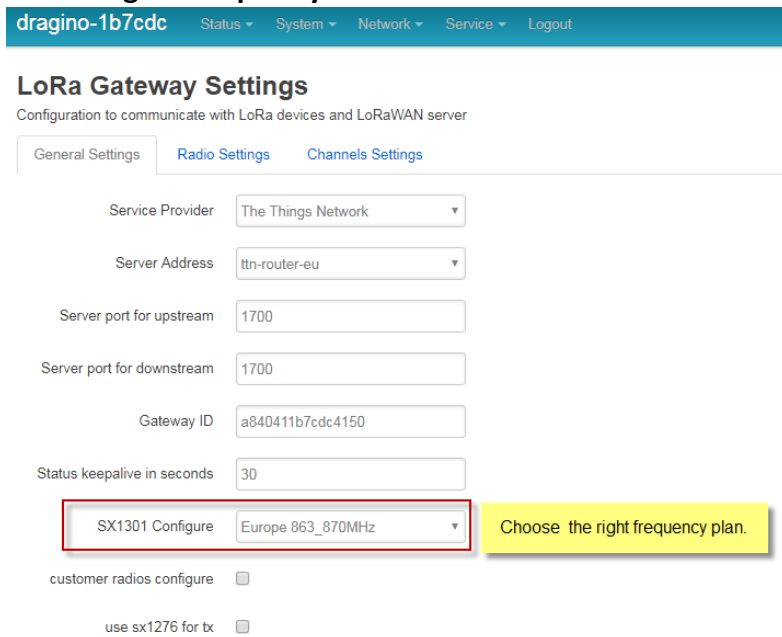
Longitude: 114.23

Check Result

After above settings, the LG308 should be able to connect to TTN, below is the result seen from TTN:



4.3 Configure frequency



After doing above LG308 will be able to act as LoRaWAN. Below section shows how to add a LoRaWAN End device in this LoRaWAN network and see the data from TTN.

We use LT-33222-L as a reference below, for other LoRaWAN devices will be more or less the same.

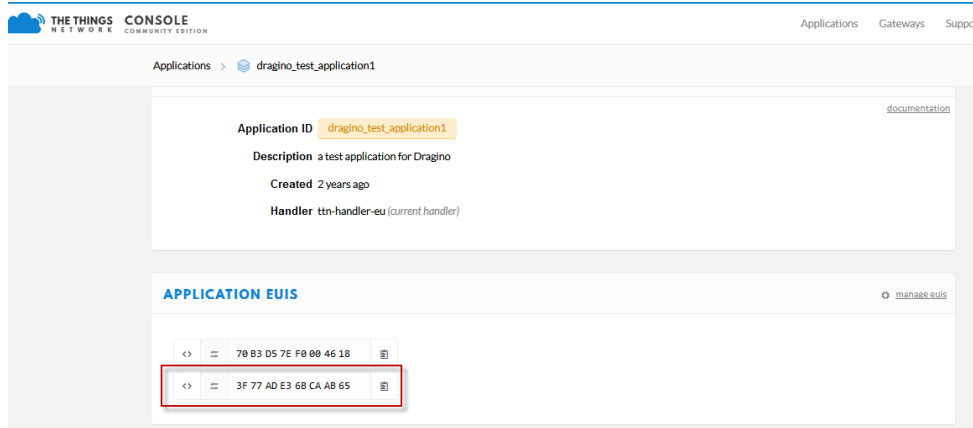
4.4 Add a LoRaWAN End Device



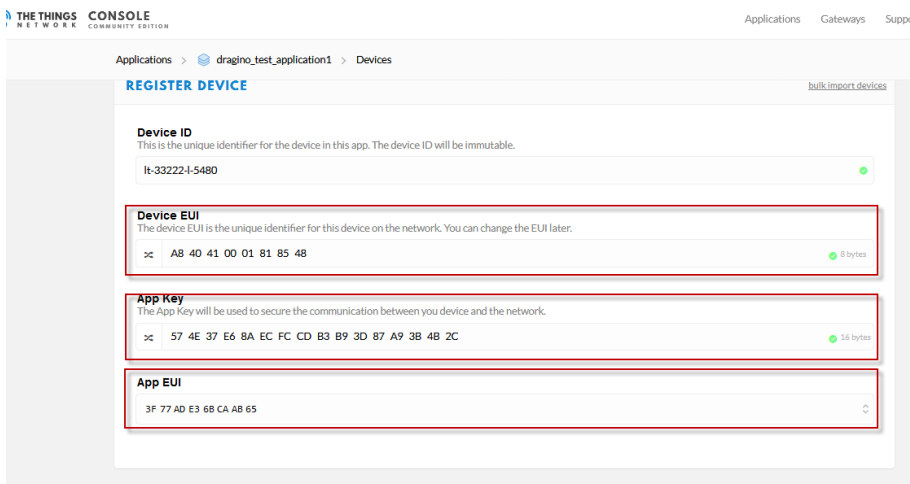
Step 1: Create a device in TTN with the OTAA keys from LT IO controller. Each LT is shipped with a sticker with the default device EUI as below:



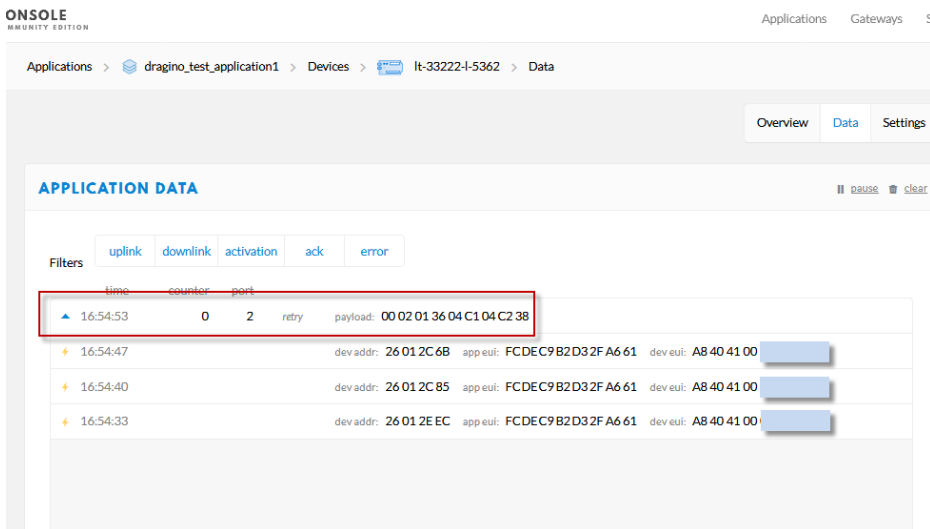
User can enter this key in their LoRaWAN Server portal. Below is TTN screen shot:
 Add APP EUI in the application.



Add APP KEY and DEV EUI



Step 2: Power on LT and it will auto join to the TTN network. After join success, it will start to upload message to TTN and user can see in the panel and analyze the data

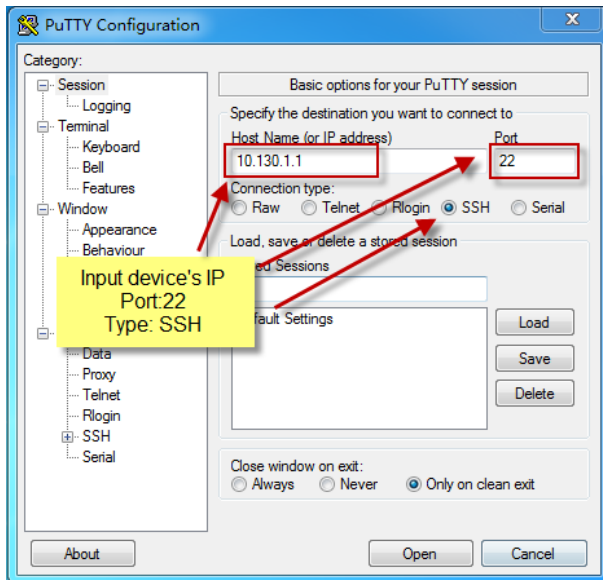


5. Linux System

The LG308 bases on OpenWrt Linux System. It is open source, and user are free to configure and modify the inside Linux settings.

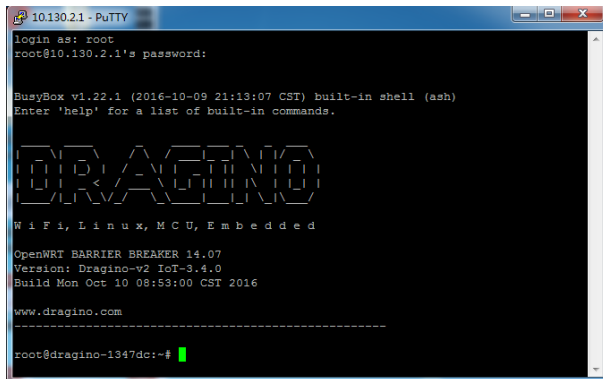
5.1 SSH Access for Linux console

User can access to the Linux console via SSH protocol. Make sure your PC and the LG01 is in the same network, then use a SSH tool (such as [putty](#)) to access it. Below are screenshots:



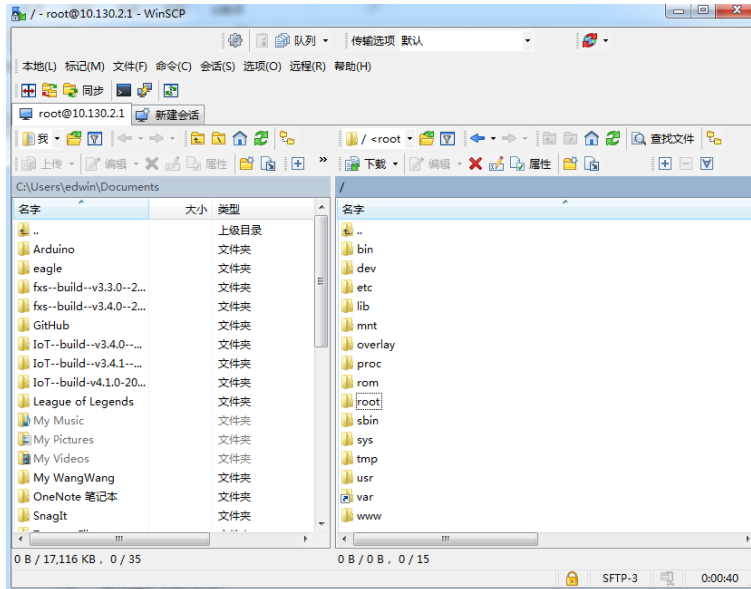
IP address: IP address of LG308
Port: 22
User Name: **root**
Password: **dragino** (default)

After log in, you will be in the Linux console and type command here.



5.2 Edit and Transfer files

The LG308 support **SCP protocol** and has a built **SFTP server**. There are many ways to edit and transfer files using these two protocols. One of the easiest is through [WinSCP](#) utility. After access via WinSCP to the device, use can use a FTP alike window to drag / drop files to the LG308 or Edit the files directly in the windows. Screenshot is as below:



5.3 File System

The LG308 has a 16MB flash and a 64MB RAM. The /var and /tmp directory are in the RAM, contents stored in /tmp and /var will be erased after reboot the device. Other directories are in the flash and will keep after reboot.

The Linux system use around 8MB ~10MB flash size which means there is not much room for user to store data in the LG308 flash. User can use an external USB flash to extend the size for storage.

5.4 Package maintain system

LG308 uses [OPKG package maintain system](#). There are more than 3000+ packages available in our package server for user to install for their applications. For example, if user wants to add iperf tool, they can install the related packages and configure LG308 to use iperf

Below is some examples opkgs command, more please refer [OPKG package maintain system](#)

In Linux Console run:

```
root@dragino-169d30:~# opkg update // to get the latest packages list
```

```
root@dragino-169d30:~# opkg list //shows the available packages
```

```
root@dragino-169d30:~# opkg install iperf // install iperf, it will auto install the required packages.
```

```
root@dragino-169d30:/etc/opkg# opkg install iperf
```

```
Installing iperf (2.0.12-1) to root...
```

```
Downloading http://downloads.openwrt.org/snapshots/packages/mips_24kc/base/iperf_2.0.12-1_mips_24kc.ipk
```

```
Installing uclibcxx (0.2.4-3) to root...
```

```
Downloading
```

```
http://downloads.openwrt.org/snapshots/packages/mips_24kc/base/uclibcxx_0.2.4-3_mips_24kc.ipk
```

```
Configuring uclibcxx.
```

```
Configuring iperf.
```

6. Upgrade Linux Firmware

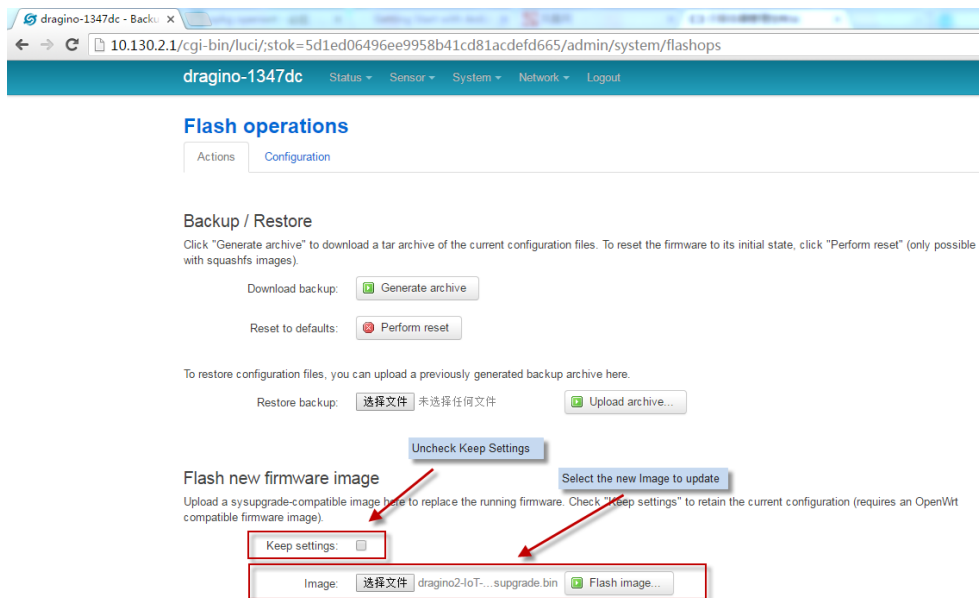
We keep improving the LG308 Linux side firmware for new features, bug fixes. The latest firmware can be found on [LoRa Gateway Firmware](#), and the Change Log can be found here: [Firmware Change Log](#).

The file named as **xxxxx--xxxxx-squashfs-sysupgrade.bin** is the upgrade Image. There are different methods to upgrade, as below:

6.1 Upgrade via Web UI

Go to the page: **Web --> System --> Back Up and flash firmware**, Select the image and click Flash Image, the image will be uploaded to the device and then click Process Update to upgrade.

System will auto boot to the new firmware after upgrade.



6.2 Upgrade via Linux console

SCP the firmware to the system **/var** directory and then run

```
root@OpenWrt:~# /sbin/sysupgrade -n /var/Your_Image
```

note: it is important to transfer the image in the **/var** directory, otherwise it may exceed the flash size.

7. FAQ

7.1 Can I make my own firmware for LG308? Where can I find the source code of LG308?

Yes, User can make own firmware for LG308 for branding purpose or add customized application.

The LG308 source code and compile instruction can be found at:

https://github.com/dragino/openwrt_lede-18.06

7.2 More FAQs about general LoRa questions

We keep updating more FAQs in our Wiki about some general questions. The link is here:

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

8. Trouble Shooting

8.1 I get kernel error when install new package, how to fix?

In some case, when install package, it will generate kernel error such as below:

```
root@dragino-16c538:~# opkg install kmod-dragino2-si3217x_3.10.49+0.2-1_ar71xx.ipk
Installing kmod-dragino2-si3217x (3.10.49+0.2-1) to root...
Collected errors:
* satisfy_dependencies_for: Cannot satisfy the following dependencies for
kmod-dragino2-si3217x:
*   kernel (= 3.10.49-1-4917516478a753314254643facdf360a) *
* opkg_install_cmd: Cannot install package kmod-dragino2-si3217x.
```

In this case, user can use the `--force-depends` option to install such package.

```
opkg install kmod-dragino2-si3217x_3.10.49+0.2-1_ar71xx.ipk --force-depends
```

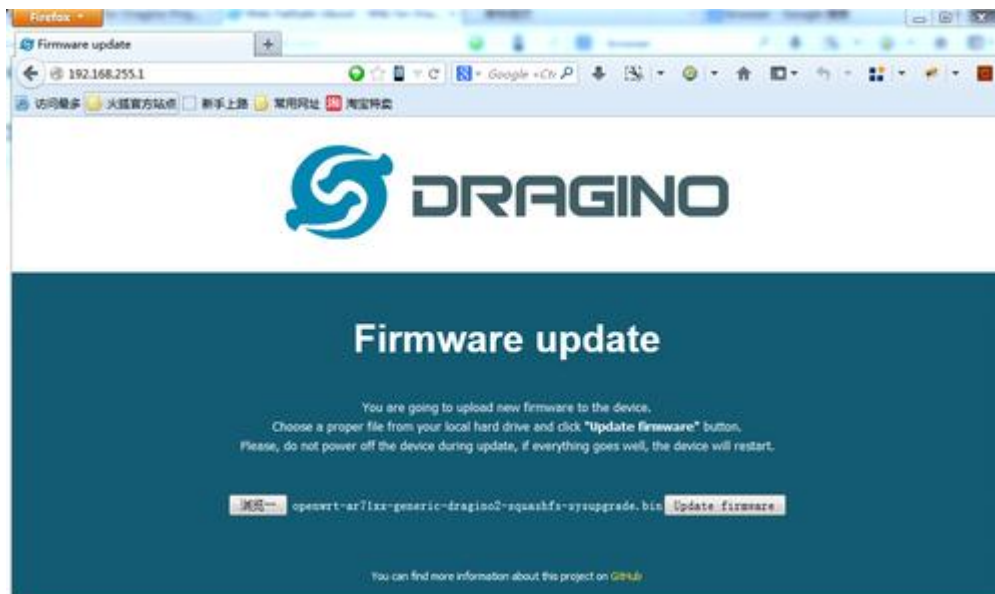
8.2 How to recover the LG308 if firmware crash

LG012 provide user a full control on its Linux system, it is possible that the device will brick and can't boot after improper modification in some booting files.

In this case, user can recover the whole Linux system by uploading a new firmware via Web Failsafe mode.

Procedure is as below:

- Use a RJ45 cable to connect the PC to LG308's port directly.
- Set the PC to ip 192.168.255.x, netmask 255.255.255.0
- Pressing the toggle button and power on the device
- All LEDs of the device will blink, release the toggle button after four blinks
- All LEDs will then blink very fast once, this means device detect a network connection and enter into the web-failsafe mode. Your PC should be able to ping 192.168.255.1 after device enter this mode.
- Open 192.168.255.1 in web browser
- Select a squashfs-sysupgrade type firmware and update firmware.



8.3 I configured LG308 for WiFi access and lost its IP. What to do now?

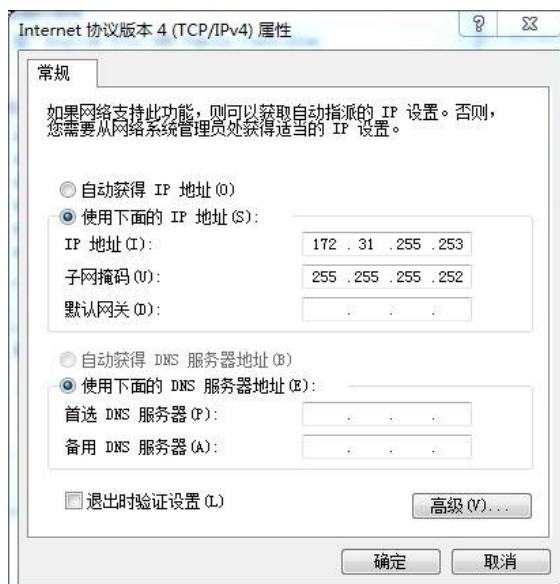
The LG01 has a fall-back ip in its LAN port. This IP is always enabled so user can use fall back ip to access LG01 no matter what the WiFi IP is. The fall back ip is useful for connect and debug the unit.

(Note: fallback ip can be disabled in the LAN and DHCP page)

Steps to connect via fall back IP:

1. Connect PC's Ethernet port to LG01's LAN port
2. Configure PC's Ethernet port has IP: 172.31.255.253 and netmask: 255.255.255.252

As below photo:



3. In PC, use 172.31.255.254 to access LG01 via Web or Console.

9. Order Info

LG308-XXX-YYY:

XXX represents frequency.

- **868**: valid frequency: 863Mhz ~ 870Mhz. for band EU868 or IN865.
- **915**: valid frequency: 902Mhz ~ 928Mhz. for bands US915, AU915, AS923 or KR920

YYY represents 4G module version:

- **EC25-E** : Equip with EC25-E for European 4G bands.

More about EC25 module model please see [Quectel EC25 model/region list](#)

10. Packing Info

Package Includes:

- ✓ LG308 or LG08 LoRa Gateway x 1
- ✓ Stick Antenna for LoRa RF part. Frequency is one of 433 or 868 or 915Mhz depends the model ordered
- ✓ Power Adapter: EU/AU/US type power adapter depends on country to be used
- ✓ Packaging with environmental protection paper box

Dimension and weight:

- ✓ Device Size: 12 x 8.5 x 3 cm
- ✓ Device Weight: 150g
- ✓ Package Size / pcs : 21.5 x 10 x 5 cm
- ✓ Weight / pcs : 360g
- ✓ Carton dimension: 45 x 31 x 34 cm. 36pcs per carton
- ✓ Weight / carton : 12.5 kg

11. Support

- Try to see if your questions already answered in the [wiki](#).
- 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

12. Reference

- ✧ Source code for LG01 LoRa Gateway
https://github.com/dragino/openwrt_lede-18.06

- ✧ OpenWrt official Wiki
<http://www.openwrt.org/>

- ✧ Firmware
http://www.dragino.com/downloads/index.php?dir=LoRa_Gateway/LG308-OLG308/Firmware/