



LG02/OLG02 LoRa Gateway User Manual

Document Version: 1.7.0

Firmware Version: lgw--build-v5.4.1607519907-20201209-2120

Version	Description	Date
1.0	Release	2018-Sep-11
1.1	Enrich content for ABP	2018-Oct-07
1.2	Add TCP_IP Client Instruction, Add Radiohead support (firmware ver > LG02_LG08--build-v5.1.1541419802-20181105-2011)	2018-Nov-5
1.3	Add notice for recover mode, add packet relay mode example. Add Example for LoRa RAW. Add Manual for MQTT mode (firmware ver > LG02_LG08--build-v5.1.1545026772-20181217-1407)	2018-Dec-27
1.4	Add Customized Script Feature (firmware ver > LG02_LG08--build-v5.1.1547896817-20190119-1921)	2019-Jan-19
1.5	-Add Downlink support and example. (firmware ver > LG02_LG08--build-v5.1.1548820215-20190130-1151) -Correct typo for the UNO code of example for lg02_single_rx_tx	2019-Jan-30
1.5.1	Add How to control LEDs, add hardware source, improve limitation description.	2019-May-13
1.5.2	Relay mode limitation, MQTT instruction	2019-Jun-19
1.5.3	Add photo for OLG02 SIM card installation	2019-Nov-01
1.5.4	--Change the HTTP Port and SSH port for firmware version > v5.3	2019-Nov-26

1.6.0	-- Add more features, remote access	2020-Mar-02
1.6.1	-- Add contents for access to the device	2020-Mar-16
1.6.2	-- Add TTN Server Notice	
1.7.0	-- Change to New UI.	2020-Dec-23

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1. Introduction

1.1 What is LG02 & OLG02

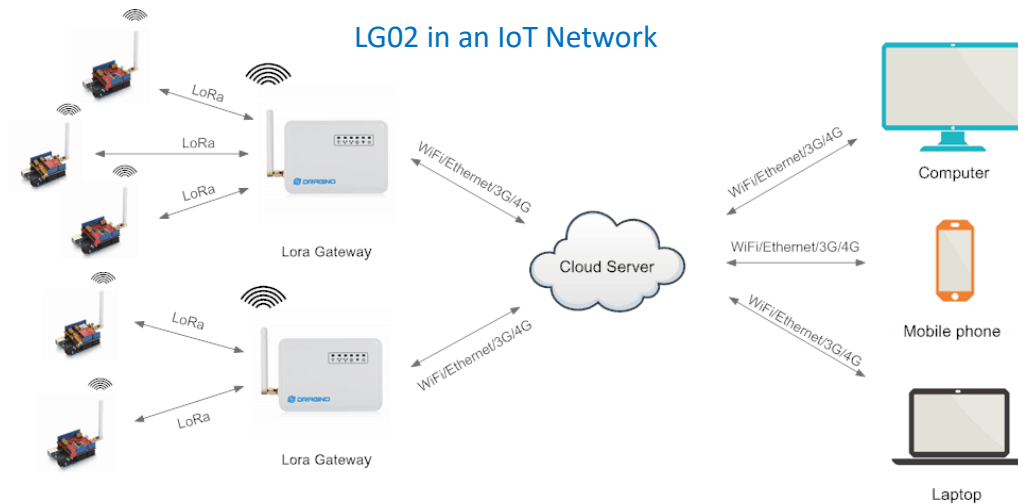
LG02 & OLG02 are an open source dual channels LoRa Gateway. It lets you bridge LoRa wireless network to an IP network via WiFi, Ethernet, 3G or 4G cellular. The LoRa wireless allows users to send data and reach extremely long ranges at low data-rates. It provides ultra-long range spread spectrum communication and high interference immunity.

LG02 & OLG02 have rich internet connection methods such as WiFi interface, Ethernet port and Cellular (Optional). These Interfaces provide flexible methods for users to connect their sensor networks to Internet.

LG02 & OLG02 can support customized LoRa transition protocol. The design of LG02 is use the Linux to directly control two sx1276/sx1278 LoRa modules which lets the LoRa can works in full duplex LoRa mode and increase the communication efficiency.

LG02 can be used to provide a low cost IoT wireless solution to support 50~300 sensor nodes.

LG02 can support multiply working mode such as: [LoRa repeater mode](#), [MQTT mode](#), [TCP/IP Client mode](#), [TCP/IP Server mode](#) to fit different requirement for IoT connection. Click this link for more info about the modes.



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
- LoRa Wireless
- Power Input: 12V DC
- USB 2.0 host connector x 1
- USB 2.0 host internal interface x 1
- 2 x LoRa Interfaces

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:

- Frequency Range:
 - ✓ Band 1 (HF): 862 ~ 1020 Mhz
 - ✓ Band 2 (LF): 410 ~ 528 Mhz
- 168 dB maximum link budget.
- +20 dBm - 100 mW constant RF output vs.
- +14 dBm high efficiency PA.
- Programmable bit rate up to 300 kbps.
- High sensitivity: down to -148 dBm.
- Bullet-proof front end: IIP3 = -12.5 dBm.
- Excellent blocking immunity.
- Low RX current of 10.3 mA, 200 nA register retention.
- Fully integrated synthesizer with a resolution of 61 Hz.
- FSK, GFSK, MSK, GMSK, LoRaTM and OOK modulation.

- Built-in bit synchronizer for clock recovery.
- Preamble detection.
- 127 dB Dynamic Range RSSI.
- Automatic RF Sense and CAD with ultra-fast AFC.
- Packet engine up to 256 bytes with CRC.
- Built-in temperature sensor and low battery indicator.

Cellular 4G LTE (optional):

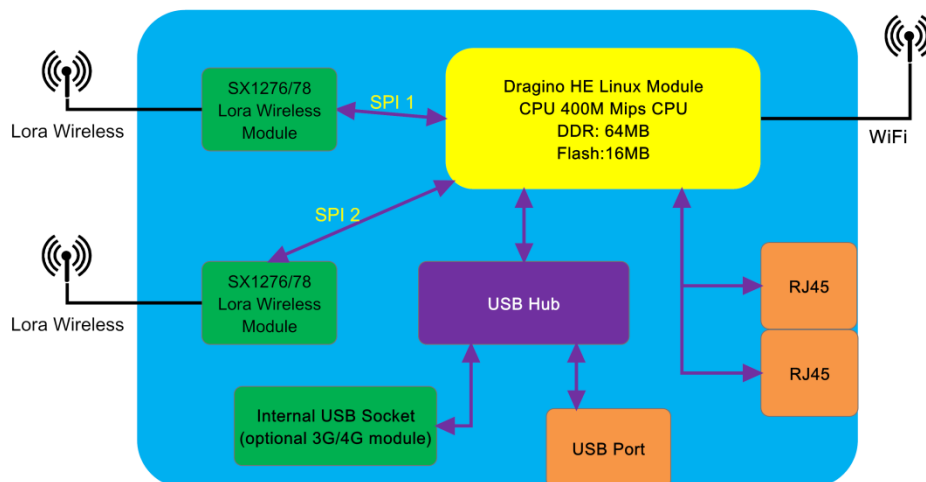
- Quectel [EC25 LTE module](#)
- Micro SIM Slot
- Internal 4G Antenna + External 4G Sticker Antenna.
- Up to 150Mbps downlink and 50Mbps uplink data rates
- Worldwide LTE, UMTS/HSPA+ and GSM/GPRS/EDGE coverage
- MIMO technology meets demands for data rate and link reliability in modem wireless communication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

1.3 Features

- ✓ Open Source OpenWrt LEDE system
- ✓ Low power consumption
- ✓ Firmware upgrade via Web
- ✓ Software upgradable via network
- ✓ Flexible protocol to connect to IoT servers
- ✓ Auto-Provisioning
- ✓ Built-in web server
- ✓ Managed by Web GUI, SSH via LAN or WiFi
- ✓ Internet connection via LAN, WiFi, 3G or 4G
- ✓ Failsafe design provides robustly system
- ✓ 2 x SX1276/SX1278 LoRa modules
- ✓ Full - duplex LoRa transceiver
- ✓ Two receive channels, and one transmit channel
- ✓ Limited support in LoRaWAN/ Support Private LoRa protocol
- ✓ Support upto 300 nodes
- ✓ LoRa band available at 433/868/915/920 Mhz
- ✓ Max range in LoRa: 5~10 km. Density Area:>500m

1.4 System Structure

LG02 System Overview:






1.5 Applications

Dragino Lora Gateway for IoT Applications



1.6 Hardware Variants

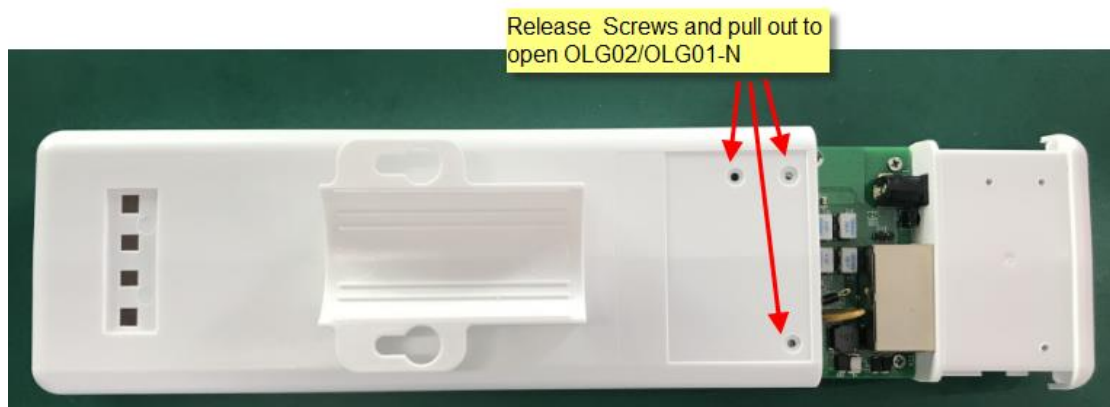
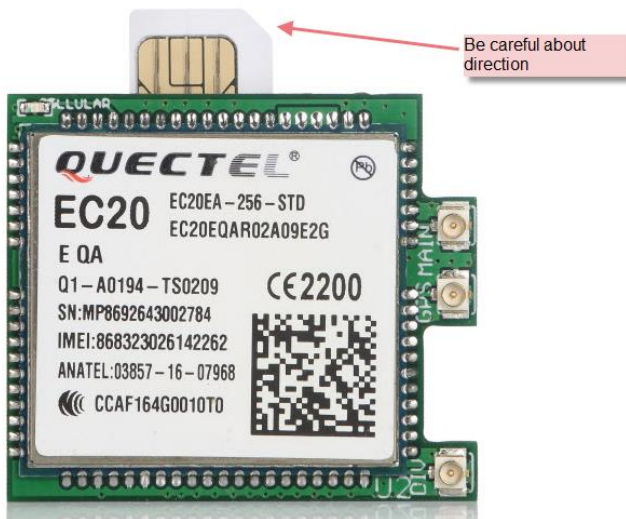
The LG02 and OLG02 use the same firmware and have the same feature in the software side. In this document, we will use LG02 to explain the feature.

Model	Photo	Description
LG02		Indoor version for dual channel LoRa Gateway, without 4G module
LG02		Indoor version for dual channel LoRa Gateway, include 4G module.
OLG02		Outdoor version for dual channel LoRa Gateway

1.7 Install SIM card in 4G module

For LG02 & OLG02 4G version, the 4G module is inside the box, please open the box and use below direction to install the SIM card

Note: Please power off when install the SIM card, and power on again after installation.



1.8 Firmware Change log

Please see this link for firmware change log:

http://www.dragino.com/downloads/index.php?dir=LoRa_Gateway/LG02-OLG02/Firmware/&file=ChangeLog

2. Access and configure LG02

The LG02 is configured as a WiFi AP by factory default. User can access and configure the LG02 after connect to its WiFi network.

2.1 Find IP address of LG02

2.1.1 Connect via WiFi



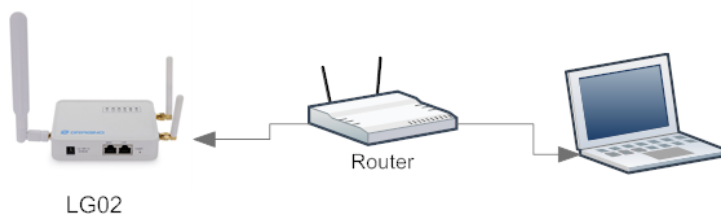
At the first boot of LG02, it will auto generate a WiFi network call **dragino-xxxxxx**

Note: In latest version firmware, it has been password protected and the password is:
dragino+dragino

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**



2.1.2 Connect via WAN port with DHCP IP from router



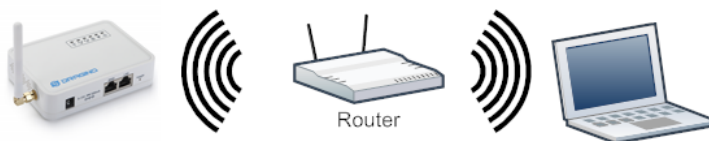
Alternatively, connect the LG02 **WAN port** to your router and LG02 will obtain an IP address from your router. In the router's management portal, you should be able to find what IP address the router has assigned to the LG02. You can also use this IP to connect.

2.1.3 Connect via LAN port with direct connection from PC



The LG02 **LAN port** is configured as DHCP router by default, user can connect the PC to LAN port and set PC to DHCP mode, the PC will get IP from LG02's LAN port and be able to access to the device. The default IP in LG02 LAN port is 10.130.1.1

2.1.4 Connect via WiFi with DHCP IP from router



If the LG02N already connect to the router via WiFi, user can use the WiFi IP to connect to LG02N.

2.1.5 Connect via LAN port by fall back ip

The **LAN port** also has a [fall back ip address](#) for access if user doesn't connect to uplink router.

2.2 Access Configure Web UI

Open a browser on the PC and type in the LG02 ip address (depends on your connect method)

<http://10.130.1.1/> (Access via WiFi AP network or LAN port)

or

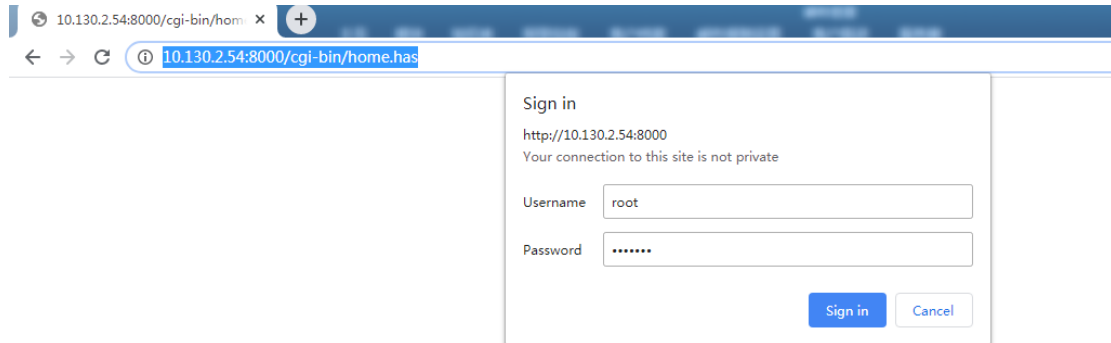
http://IP_ADDRESS or http://IP_ADDRESS:8000 (The web port has been changed to 8000 in **WAN interface**(WAN port or WiFi Client Mode) since firmware 5.3.xxx firmware)

User will see the login interface of LG02.

The account for Web Login is:

User Name: root

Password: dragino



3. Typical Network Setup

3.1 Overview

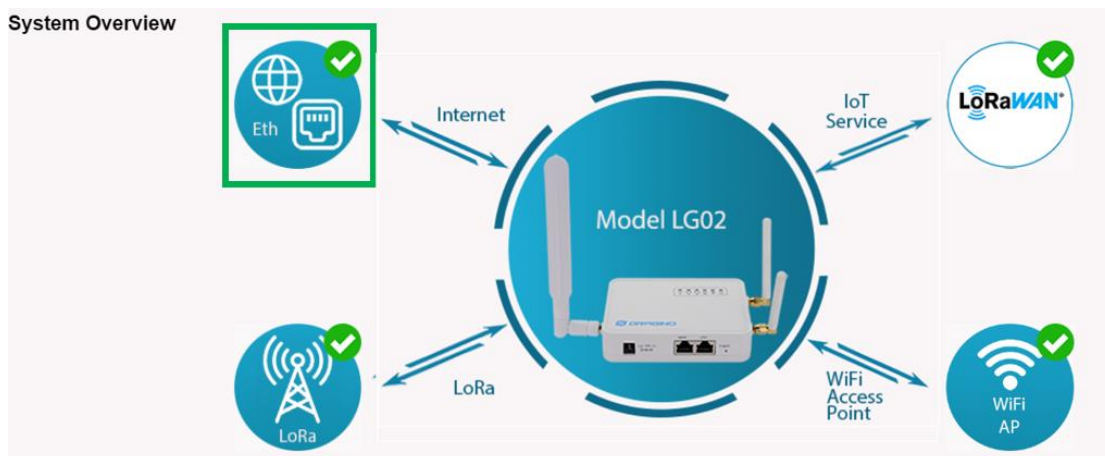
LG02 supports flexible network set up for different environment. This section describes the typical network topology can be set in LG02. The typical network set up includes:

- ✓ **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 LG02 set to use WAN port as network connection. When connect LG02's WAN port to router, LG02 will get IP from router and have internet access. The network status can be checked as below:

System Overview



3.3 Access Internet as a WiFi Client.

In the WiFi Client Mode, LG02 acts as a WiFi client and gets DHCP from an upstream router via WiFi.

The settings for WiFi Client are under page [System](#) → [WiFi](#) → [WiFi WAN Client Settings](#)

WiFi

Radio Settings

Channel (1-11) Tx Power (0-18) dBm

WiFi Access Point Settings

Enable WiFi Access Point

WiFi Name SSID

Passphrase (8-32 char) [Show](#) Encryption

WiFi WAN Client Settings

Enable WiFi WAN Client

Host WiFi SSID WiFi Survey

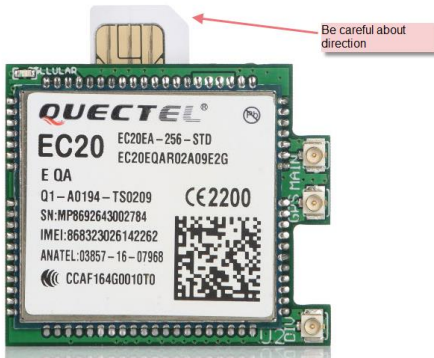
Passphrase [Show](#) Encryption

In the WiFi Survey Choose the WiFi AP, and input the Passphrase then click Save & Apply to connect.

3.4 Use built-in 4G modem for internet access

If the LG02 has 3G/4G Cellular modem, user can use it as main internet connection or back up.

First, install the Micro SIM card as below direction



Second, Power off/ ON LG02 to let it detect the SIM card.

The set up page is [System](#) → [Cellular](#)

While use the cellular as Backup WAN, device will use Cellular for internet connection while WAN port or WiFi is not valid and switch back to WAN port or WiFi after they recover.




Cellular Settings

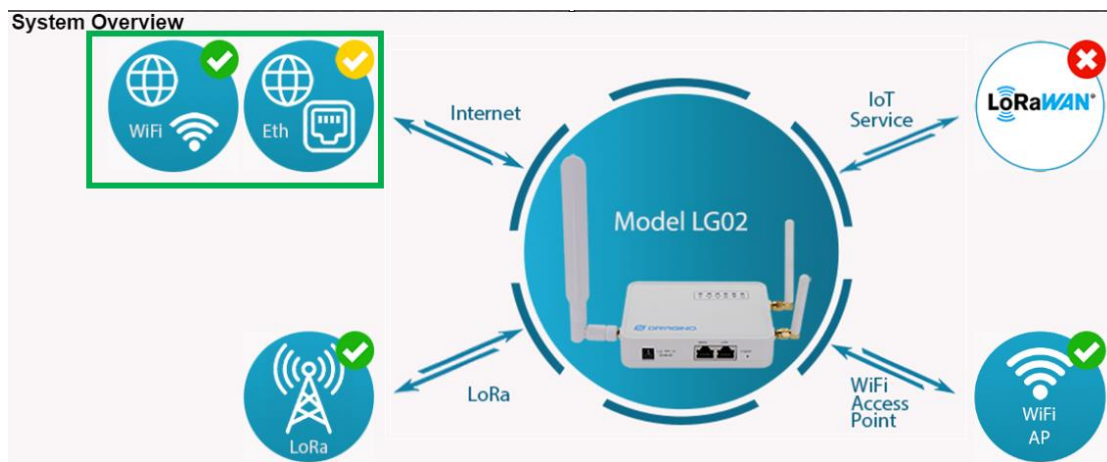
- Enable Cellular WAN
- Use Cellular as Backup WAN

APN	<input type="text" value="3gnet"/>
Service	<input type="text" value="UMTS / GPRS"/>
Dial Number	<input type="text" value="*99#"/>
Pincode	<input type="text" value="SIM Pincode"/>
Username	<input type="text" value="SIM Acct Username"/>
Password	<input type="text" value="SIM Acct Password"/> Show

3.5 Check Internet connection

In the [Home](#) page, we can check the Internet connection.

- GREEN Tick  : This interface has Internet connection.
- Yellow Tick  : This interface has IP address but don't use it for internet connection.
- RED Cross  : This interface doesn't connected.



4. Example 1: Control LoRa radio directly as general LoRa transceiver

4.1 User LoRa Radio via pkt_fwd

4.2 Use pkt_fwd to receive

When user chooses the MQTT/TCP-IP/Customized mode, the lg02_pkt_fwd will auto start. It will listen the LoRa Radio Channel 1 base on the setting in the web setting.

LoRa Configuration

Debug Level

Radio 1 RX Settings

Frequency (Hz)	<input type="text" value="916000000"/>	RF Bandwidth (Hz)	<input type="text" value="125kHz"/>
Spreading Factor	<input type="text" value="SF10"/>	Coding Rate	<input type="text" value="4/5"/>
Preamble Length	<input type="text" value="8"/>	LoRa Sync Word	<input type="text" value="52"/>

Radio 2 TX Settings

Frequency (Hz)	<input type="text" value="915000000"/>	RF Bandwidth (Hz)	<input type="text" value="125kHz"/>
Spreading Factor	<input type="text" value="SF7"/>	Coding Rate	<input type="text" value="4/5"/>
Preamble Length	<input type="text" value="8"/>	LoRa Sync Word	<input type="text" value="52"/>
RF Power (0-20) dBm	<input type="text" value="20"/>		

Enable LoRaWAN/RAW Relay Mode

Enable Relay Mode Caution: Enabling Relay Mode will disable other LoRaWAN modes

Static GPS coordinates ?

Enable Static GPS	<input checked="" type="checkbox"/>	Altitude (m)	<input type="text" value="450"/>
Latitude	<input type="text" value="22.700000"/>	Longitude	<input type="text" value="114.240000"/>

If the LoRa end node send data in the match format, the pkt_fwd will store the data for further use, the logic of this receive part please see [Customized Script](#).

4.3 Use pkt_fwd to transmit

The pkt_fwd also open a thread to listen to local files under directory `/var/iot/push/`. Once there is a file in this directory, the thread will check if it is an outgoing file and send out the LoRa message if format match. Below is the file example (json format):

```
{
  "txpk": {
    "imme": false,
    "tmst": 861608339,
    "freq": 925.1,
    "rfch": 0,
    "pove": 20,
    "modu": "LORA",
    "datr": "SF7BW500",
    "codr": "4/5",
    "ipol": true,
    "size": 22,
    "ncrc": true,
    "data": "YEklBCaqCgADQAIAcQM6AP8B9TYzUA=="
  }
}
```

Explain:

Name	Type	Function
------	------	----------

```

:-----:|:------:|-----
imme | bool    | Send packet immediately (will ignore tmst & time)
tmst  | number  | Send packet on a certain timestamp value (will ignore time)
tmms  | number  | Send packet at a certain GPS time (GPS synchronization required)
freq  | number  | TX central frequency in MHz (unsigned float, Hz precision)
rfch  | number  | Concentrator "RF chain" used for TX (unsigned integer)
powe  | number  | TX output power in dBm (unsigned integer, dBm precision)
modu  | string  | Modulation identifier "LORA" or "FSK"
datr  | string  | LoRa datarate identifier (eg. SF12BW500)
datr  | number  | FSK datarate (unsigned, in bits per second)
codr  | string  | LoRa ECC coding rate identifier
fdev  | number  | FSK frequency deviation (unsigned integer, in Hz)
ipol  | bool    | Lora modulation polarization inversion
prea  | number  | RF preamble size (unsigned integer)
size  | number  | RF packet payload size in bytes (unsigned integer)
data  | string  | Base64 encoded RF packet payload, padding optional
nrcr  | bool    | If true, disable the CRC of the physical layer (optional)

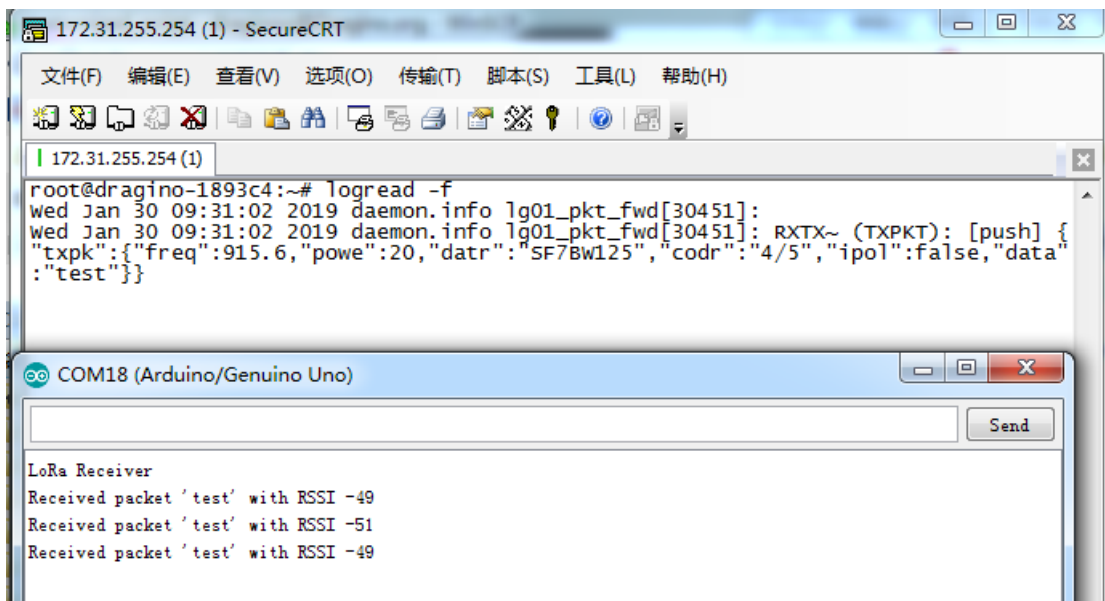
```

Not all field are necessary, below is an example:

- 1) First set up a LoRa Shield with this code: [LoRaReceiver](#). So the LoRa Shield will receive the data at frequency 915.6Mhz, SF7BW125, CR: 4/5
- 2) Edit a file (any name) under `/var/iot/push/` with below content.

```
{ "txpk": { "freq": 915.6, "powe": 20, "datr": "SF7BW125", "codr": "4/5", "ipol": false, "data": "test" } }
```

And then we can see below output

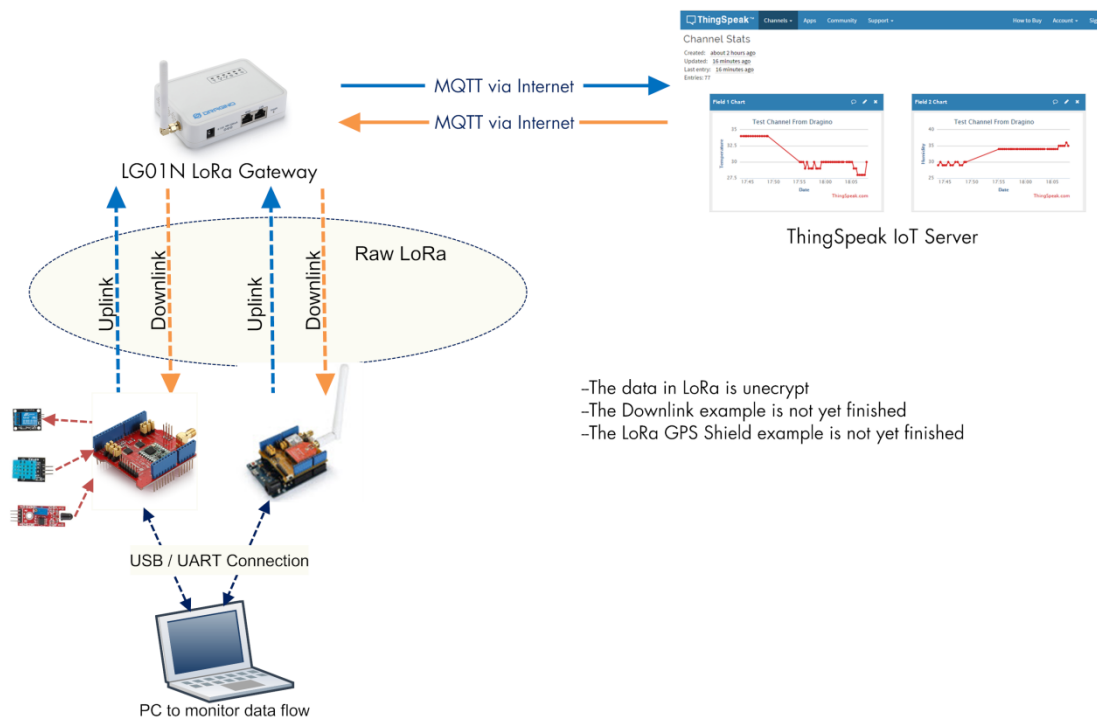


5. Example 2: MQTT Transfer Mode

MQTT is a machine-to-machine (M2M)/"Internet of Things" connectivity protocol. It was designed as an extremely lightweight publish/subscribe messaging transport. It is useful for connections with remote locations where a small code footprint is required and/or network bandwidth is at a premium. For example, it has been used in sensors communicating to a broker via satellite link, over occasional dial-up connections with healthcare providers, and in a range of home automation and small device scenarios.

Most IoT server support MQTT connection, for those servers, we can use MQTT to connect it to publish data or subscribe to a channel.

Topology for ThingSpeak Connection:



Most IoT server support MQTT connection, for those servers, we can use MQTT to connect it to publish data or subscribe to a channel.

A detail of how to use MQTT plus Video instruction can be found at:

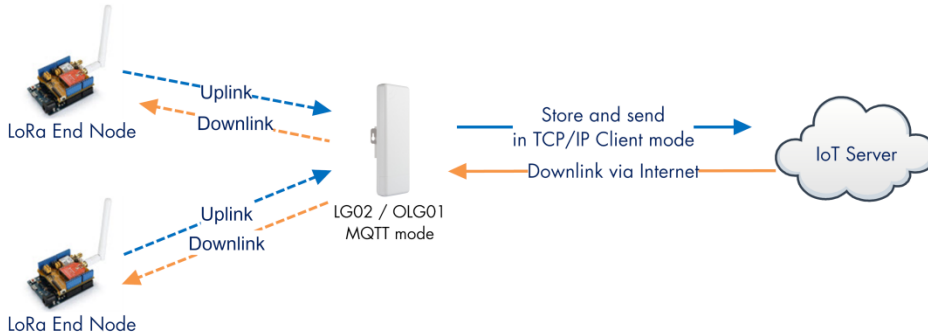
http://wiki.dragino.com/index.php?title=MQTT_Forward_Instruction

6. Example 3: TCP IP Client Mode

In the TCP IP Client mode, LG02 can accept LoRa packets and send it to the TCP-IP server. The working topology is as below. In this mode, The Uplink LoRa packets should use a customized format.

TCP/IP Client mode:

Use LG02 / OLG02 as a LoRa Gateway to forward packet to IoT Server in TCP/IP Client Mode



Operate Principle:

- > The LoRa end node sends data to LG02 gateway via private LoRa protocol. LG02 stores the sensor data.
- > LG02 sends the sensor data to IoT Server via general TCP/IP Client mode.

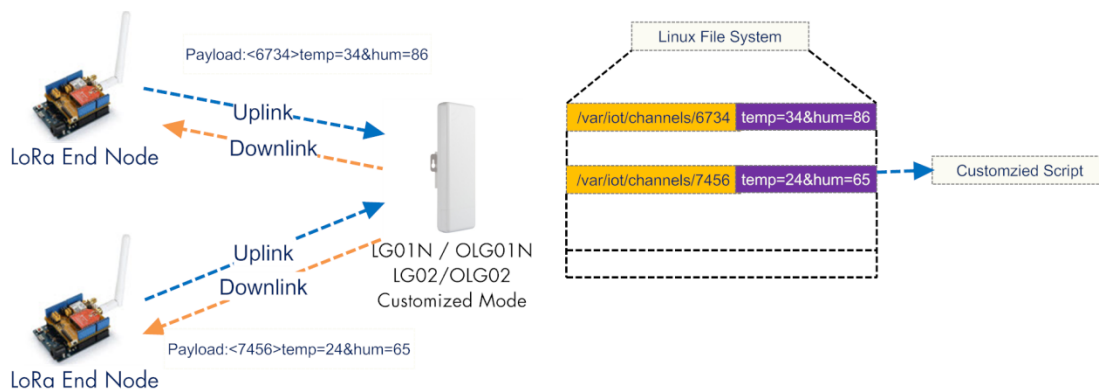
Tutorial: http://wiki.dragino.com/index.php?title=TCP_Connection_Instruction

7. Example 5: Write a customized script

LG02 supports customized script to process LoRa data. This chapter describes about the data format from LoRa End node and How to write the script.

The data flow from LoRa End Node to LG02 is as below:

How customized script works:



Operate Principle:

- > LoRa End Node sends the data to gateway in specify format: <node_ID>value
- > Gateway get the data and will put the data in corresponding files under /var/iot/channels.
- > The customized script interact with these channels files. So developer can focus on writing this script.

Example: Store Data in a file.

Step 1: Choose LoRa customized script mode

The screenshot shows the 'Custom Script' configuration page. At the top, there is a navigation bar with the Dragino logo and several menu items: LoRa, LoRaWAN, HTTP, MQTT, TCP, Custom, Network, and System. Below the navigation bar, the page title is 'Custom Script'. A sub-header reads: 'Run a Custom Script to process LoRa Data. Parameters are optional and defined in the script.' The main configuration area contains a 'Script Name' dropdown menu set to 'store_data_to_file'. Below this are ten parameter input fields, labeled 'Parameter 1' through 'Parameter 10'. 'Parameter 1' contains the text '/var/sensor_data', while the others are empty. At the bottom of the form are two buttons: 'Save&Apply' and 'Cancel'.

Step 2: Configure LoRa Radio parameters to match the LoRa End Node.

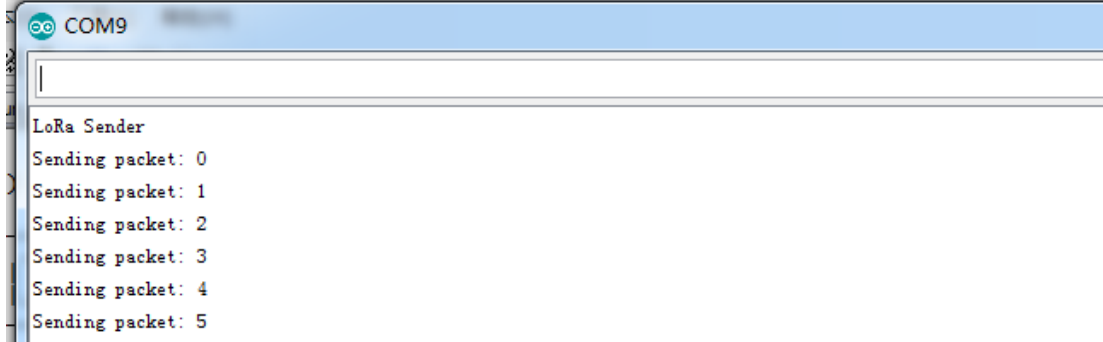
The screenshot shows the 'LoRa Configuration' page. The navigation bar is similar to the previous page but includes an additional 'LogRead' menu item. Below the navigation bar, the page title is 'LoRa Configuration'. A 'Debug Level' dropdown menu is set to 'Low'. The main configuration area is divided into two sections: 'Radio 1 RX Settings' and 'Radio 2 TX Settings'. The 'Radio 1 RX Settings' section is highlighted with a red rectangular box and contains the following parameters: Frequency (Hz) set to 916000000, Spreading Factor set to SF10, Preamble Length set to 8, RF Bandwidth (Hz) set to 125kHz, Coding Rate set to 4/5, and LoRa Sync Word set to 52. The 'Radio 2 TX Settings' section contains: Frequency (Hz) set to 915000000, Spreading Factor set to SF7, Preamble Length set to 8, RF Power (0-20) dBm set to 20, RF Bandwidth (Hz) set to 125kHz, Coding Rate set to 4/5, and LoRa Sync Word set to 52.

Step 3: Configure the LoRa End Device to send sensor data.

Here is an example code for LoRa Shield: [End Device Code](#)

Outputs:

End node send out packages:



```

COM9
LoRa Sender
Sending packet: 0
Sending packet: 1
Sending packet: 2
Sending packet: 3
Sending packet: 4
Sending packet: 5
    
```

Gateway receive packet & Script find packet

```

root@dragino-1b81c8:~# logread -f
Sun Jan 1 00:47:08 2012 user.notice root: [IoT]: Found field1=25&field2=87 at Local Channel: 10009
Sun Jan 1 00:47:08 2012 user.notice root: [IoT]: Append at /var/sensor_data
Sun Jan 1 00:47:13 2012 daemon.info lg02_pkt_fwd[31105]: RXTX~ Receive(HEX):3c31303030393e6669656c64313d3239266669656c64323d3933
Sun Jan 1 00:47:14 2012 user.notice root: [IoT]: Found field1=29&field2=93 at Local Channel: 10009
Sun Jan 1 00:47:14 2012 user.notice root: [IoT]: Append at /var/sensor_data
Sun Jan 1 00:47:23 2012 daemon.info lg02_pkt_fwd[31105]: RXTX~ Receive(HEX):3c31303030393e6669656c64313d3238266669656c64323d3934
Sun Jan 1 00:47:23 2012 daemon.info lg02_pkt_fwd[31105]: RXTX~ Receive(HEX):3c31303030393e6669656c64313d3238266669656c64323d3934
Sun Jan 1 00:47:26 2012 user.notice root: [IoT]: Found field1=28&field2=94 at Local Channel: 10009
Sun Jan 1 00:47:26 2012 user.notice root: [IoT]: Append at /var/sensor_data
    
```

Script store data into file

```

root@dragino-1b81c8:~# cat /var/sensor_data
Sun Jan 1 00:15:26 UTC 2012 :<1234> 123443
Sun Jan 1 00:46:26 UTC 2012 :<10009> field1=32&field2=94
Sun Jan 1 00:46:44 UTC 2012 :<10009> field1=32&field2=94
Sun Jan 1 00:46:56 UTC 2012 :<10009> field1=28&field2=93
Sun Jan 1 00:47:08 UTC 2012 :<10009> field1=25&field2=87
Sun Jan 1 00:47:14 UTC 2012 :<10009> field1=29&field2=93
Sun Jan 1 00:47:26 UTC 2012 :<10009> field1=28&field2=94
Sun Jan 1 00:47:38 UTC 2012 :<10009> field1=25&field2=90
Sun Jan 1 00:47:44 UTC 2012 :<10009> field1=27&field2=87
Sun Jan 1 00:47:56 UTC 2012 :<10009> field1=32&field2=88
Sun Jan 1 00:48:08 UTC 2012 :<10009> field1=32&field2=94
Sun Jan 1 00:48:20 UTC 2012 :<10009> field1=25&field2=87
Sun Jan 1 00:48:26 UTC 2012 :<10009> field1=28&field2=94
Sun Jan 1 00:48:38 UTC 2012 :<10009> field1=34&field2=92
Sun Jan 1 00:48:50 UTC 2012 :<10009> field1=25&field2=88
Sun Jan 1 00:48:56 UTC 2012 :<10009> field1=34&field2=93
Sun Jan 1 00:49:08 UTC 2012 :<10009> field1=31&field2=90
Sun Jan 1 00:49:20 UTC 2012 :<10009> field1=32&field2=91
Sun Jan 1 00:49:26 UTC 2012 :<10009> field1=27&field2=92
Sun Jan 1 00:49:38 UTC 2012 :<10009> field1=25&field2=88
    
```

8. Example 5: LoRaWAN Packet Relay mode

The LG02 has two radio channels, we can use these two channels as LoRaWAN relay to improve the network coverage. Please upgrade to this firmware [lgw--build-v5.4.1600788314-20200922-2327](#) or higher to support relay mode.

8.1 How it works

Basic concept: Get data in Radio 1 with match frequency/DR, transmit the same data on Radio2 with pre-configure frequency and DR.

This mode works for below LoRa protocol:

- ✓ LoRaWAN ABP mode and only be able to relay one frequency.
- ✓ Radiohead Library.
- ✓ Simple LoRa protocol.

Configuration is as below:

a) Enable Relay mode

b) Set the frequency and spreading factor want to monitor.

c) Set the frequency and spreading factor want to transmit.

Note: TX and RX can set to same parameter or different.

LoRa Configuration

Debug Level Low ▾

Radio 1 RX Settings

Frequency (Hz)

Spreading Factor

Preamble Length

RF Bandwidth (Hz) 125kHz ▾

Coding Rate 4/5 ▾

LoRa Sync Word

Radio 2 TX Settings

Frequency (Hz)

Spreading Factor

Preamble Length

RF Power (0-20) dBm

RF Bandwidth (Hz) 125kHz ▾

Coding Rate 4/5 ▾

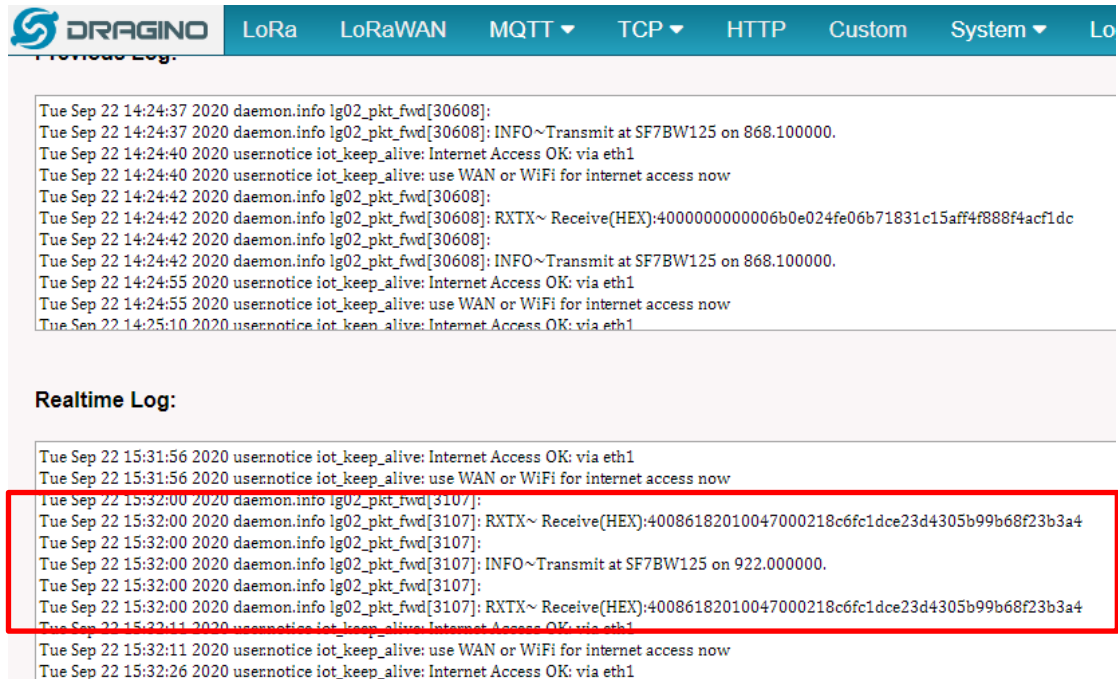
LoRa Sync Word

Enable LoRaWAN/RAW Relay Mode

Enable Relay Mode Caution: Enabling Relay Mode will disable other LoRaWAN modes

As per above settings, LG02 will listening on channel: 922.0Mhz / SF7 . If there is a device transmit LoRa/LoRaWAN packet on this channel, LG02 will get this packet and forward it to another LoRa channel 922.0Mhz/ SF7. In this case, LG02 help the end node to transmit for longer distance.

User can see the debug info from [logread](#) → [System Log](#). As below, lg02 receive a packet on 15:32:00, then LG02 immediately transmit to 922.0Mhz, SF7, because LG02 keep listening this channel, it receive the packet again, but this time LG02 won't transmit it as it will judge this packet is a duplicate one.



System Log:

```
Tue Sep 22 14:24:37 2020 daemon.info lg02_pkt_fwd[30608]:
Tue Sep 22 14:24:37 2020 daemon.info lg02_pkt_fwd[30608]: INFO~Transmit at SF7BW125 on 868.100000.
Tue Sep 22 14:24:40 2020 usernotice iot_keep_alive: Internet Access OK: via eth1
Tue Sep 22 14:24:40 2020 usernotice iot_keep_alive: use WAN or WiFi for internet access now
Tue Sep 22 14:24:42 2020 daemon.info lg02_pkt_fwd[30608]:
Tue Sep 22 14:24:42 2020 daemon.info lg02_pkt_fwd[30608]: RXTX~ Receive(HEX):400000000006b0e024fe06b71831c15aff4f888f4acf1dc
Tue Sep 22 14:24:42 2020 daemon.info lg02_pkt_fwd[30608]:
Tue Sep 22 14:24:42 2020 daemon.info lg02_pkt_fwd[30608]: INFO~Transmit at SF7BW125 on 868.100000.
Tue Sep 22 14:24:55 2020 usernotice iot_keep_alive: Internet Access OK: via eth1
Tue Sep 22 14:24:55 2020 usernotice iot_keep_alive: use WAN or WiFi for internet access now
Tue Sep 22 14:25:10 2020 usernotice iot_keep_alive: Internet Access OK: via eth1
```

Realtime Log:

```
Tue Sep 22 15:31:56 2020 usernotice iot_keep_alive: Internet Access OK: via eth1
Tue Sep 22 15:31:56 2020 usernotice iot_keep_alive: use WAN or WiFi for internet access now
Tue Sep 22 15:32:00 2020 daemon.info lg02_pkt_fwd[3107]:
Tue Sep 22 15:32:00 2020 daemon.info lg02_pkt_fwd[3107]: RXTX~ Receive(HEX):40086182010047000218c6fc1dce23d4305b99b68f23b3a4
Tue Sep 22 15:32:00 2020 daemon.info lg02_pkt_fwd[3107]:
Tue Sep 22 15:32:00 2020 daemon.info lg02_pkt_fwd[3107]: INFO~Transmit at SF7BW125 on 922.000000.
Tue Sep 22 15:32:00 2020 daemon.info lg02_pkt_fwd[3107]:
Tue Sep 22 15:32:00 2020 daemon.info lg02_pkt_fwd[3107]: RXTX~ Receive(HEX):40086182010047000218c6fc1dce23d4305b99b68f23b3a4
Tue Sep 22 15:32:11 2020 usernotice iot_keep_alive: Internet Access OK: via eth1
Tue Sep 22 15:32:11 2020 usernotice iot_keep_alive: use WAN or WiFi for internet access now
Tue Sep 22 15:32:26 2020 usernotice iot_keep_alive: Internet Access OK: via eth1
```

8.2 Limitation for Relay Mode

While use relay mode to enlarge the LoRaWAN coverage, there is limitation because the LG02 only listen one Frequency and DR, while the LoRaWAN end node transmit the data on multiply frequency and different DR. For example, in EU868 LoRaWAN, the end node LoRaWAN settings are:

EU863-870

Uplink:

- 868.1 - SF7BW125 to SF12BW125
- 868.3 - SF7BW125 to SF12BW125 and SF7BW250
- 868.5 - SF7BW125 to SF12BW125
- 867.1 - SF7BW125 to SF12BW125
- 867.3 - SF7BW125 to SF12BW125
- 867.5 - SF7BW125 to SF12BW125
- 867.7 - SF7BW125 to SF12BW125
- 867.9 - SF7BW125 to SF12BW125
- 868.8 – FSK

Downlink:

Uplink channels 1-9 (RX1)

869.525 - SF9BW125 (RX2 downlink only)

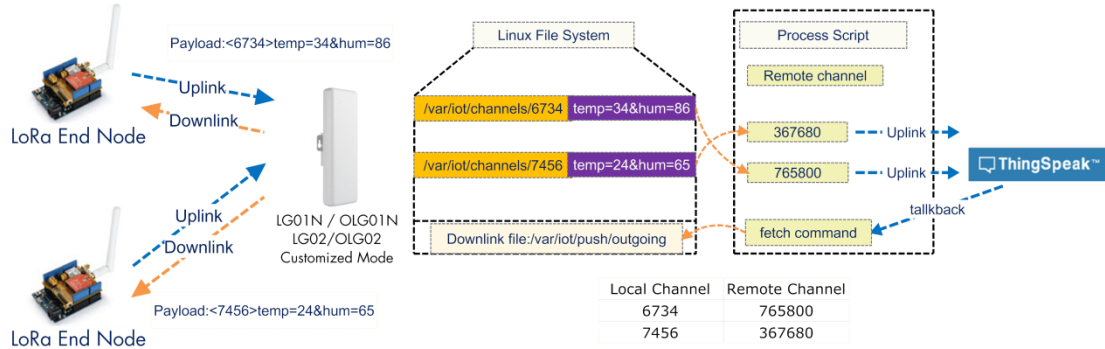
For uplink: if we set LG02 to listen on 868.3 , SF7, BW125, and transmit at 868.3,SF7,BW125. The LG02 will receive all end node's packet at 868.3 SF7BW125 and can't receive other frequency from end node. Which means the LG02 can only extend the uplink for 868.3 SF7BW125.

For downlink: Due to IQ inverter issue, the end node can't get relay packet from LG02. So OTAA mode can't work. User need to use ABP mode.

9. Example 6: Communicate to a HTTP server

Here shows an example for how to communicate to ThingSpeak server via HTTP protocol.

Communicate with thingspeak via HTTP GET/POST:



Operate Principle:

- > LoRa End Node sends the data to gateway in specify format: <node_ID>value
- > Gateway get the data and will put the data in corresponding files under /var/iot/channels.
- > HTTP Process Script will put the data to remote channel according to the pre-configure mapping
- > HTTP Process Script will run curl command to check the talkback command from server. If there is talkback command, it willlll construct a outgoing file under /var/iot/push for downlink purpose.

9.1 Test uplink and downlink via Linux command

We can see the API requests method in ThingSpeak API keys tab.

dragino-test

Channel ID: 396640
Author: dragino1
Access: Private

Private View Public View Channel Settings Sharing API Keys Data Import / Export

Write API Key

Key: P07KVY59P5QEY6M6

Generate New Write API Key

Read API Keys

Key: WJXRGTMTWADPVQNF

Note:

Help

API keys enable you to write data to a channel or read data from a private channel. API keys are auto-generated when you create a new channel.

API Keys Settings

- **Write API Key:** Use this key to write data to a channel. If you feel your key has been compromised, click **Generate New Write API Key**.
- **Read API Keys:** Use this key to allow other people to view your private channel feeds and charts. Click **Generate New Read API Key** to generate an additional read key for the channel.
- **Note:** Use this field to enter information about channel read keys. For example, add notes to keep track of users with access to your channel.

API Requests

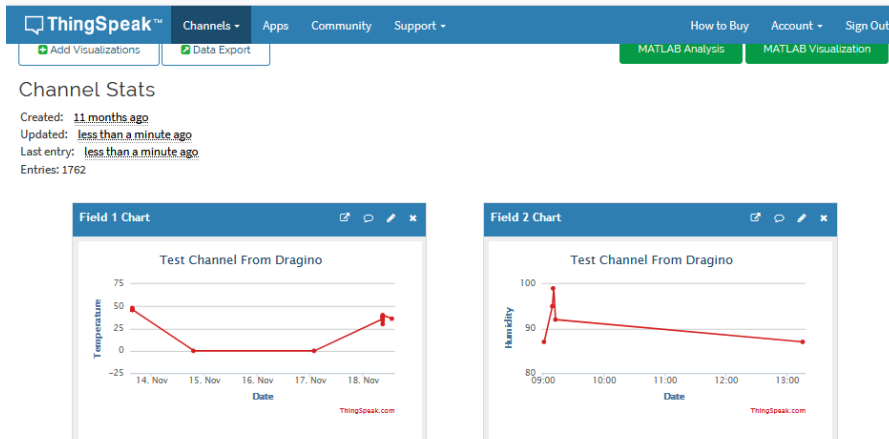
Update a Channel Feed

GET https://api.thingspeak.com/update?api_key=P07KVY59P5QEY6M6&field1=0

Run curl command to use this API (update a channel feed) :

```
172.31.255.254 (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)
172.31.255.254 (1)
root@dragino-1893c4:~# curl -k --get "https://api.thingspeak.com/update?api_key=P07KVY59P5QEY6M6&field1=35&field2=98"
4310root@dragino-1893c4:~#
```

And we will be able to see the update in the feed:



ThingSpeak has a talkback API which can dispatch command, it is under Apps → Talkback

We can use curl command to get command_string, as below:

```
172.31.255.254 (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)
172.31.255.254 (1)
root@dragino-1893c4:~# curl -k "https://api.thingspeak.com/talkbacks/30660/commands/execute.json" --data "api_key=J23X4Y9MTCZNH9Y0"
root@dragino-1893c4:~# curl -k "https://api.thingspeak.com/talkbacks/30660/commands/execute.json" --data "api_key=J23X4Y9MTCZNH9Y0"
{"id":15071098,"command_string":"downlinkcommand","position":null,"executed_at":"2019-01-30T10:22:38Z","created_at":"2019-01-30T10:22:29Z"}root@dragino-1893c4:~#
```

9.2 Test uplink and downlink in LoRa

9.2.1 Set up on gateway

Step1:

Run below commands to download the customized script for ThingSpeak:

```
root@dragino-1893c4:~# wget http://www.dragino.com/downloads/downloads/LoRa_Gateway/LG02-OLG02/Firmware/customized_script/uplink_downlink_ThingSpeak.sh
root@dragino-1893c4:~# chmod +x uplink_downlink_ThingSpeak.sh
root@dragino-1893c4:~# mv uplink_downlink_ThingSpeak.sh /etc/lora/customized_scripts/
```

Step2:

Modify the script `uplink_downlink_ThingSpeak.sh` for your channels:

There are three places need to modify:

1. Replace the channel with the corresponding channel ID and API KEY

```
if [ "$channel" == "396640" ];then
    WRITE_API_KEY="P07KVY59P5QEY6M6"
fi
```

- 2.

talkback=`curl Replace with the actually talk back URL

3. Modify this line with the suitable frequency.

```
echo "{\"txpk\":{\"freq\":915.0,\"powe\":2
```

Step3:

Select ThingSpeak script as the customized script.

Custom Script

Run a Custom Script to process LoRa Data. Parameters are optional and defined in the script.

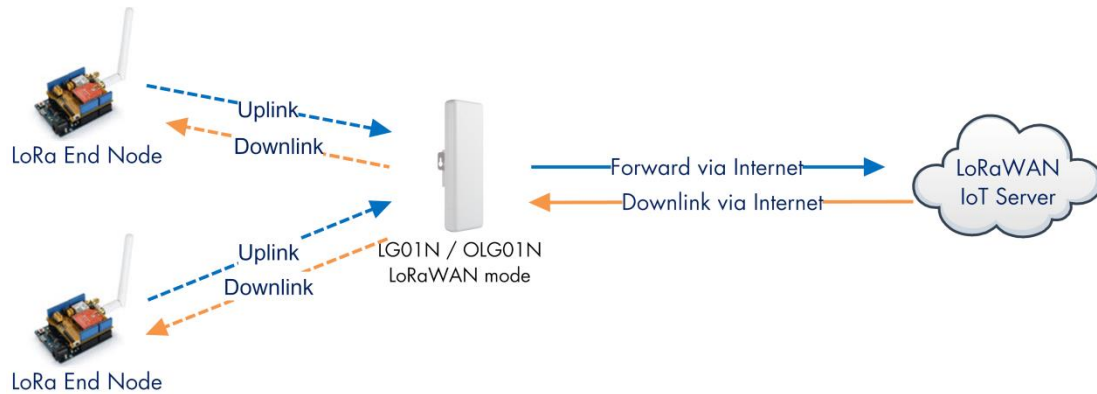
Script Name

Parameter 1 <input type="text" value="/var/sensor_data"/>	Parameter 2 <input type="text"/>
Parameter 3 <input type="text"/>	Parameter 4 <input type="text"/>
Parameter 5 <input type="text"/>	Parameter 6 <input type="text"/>
Parameter 7 <input type="text"/>	Parameter 8 <input type="text"/>
Parameter 9 <input type="text"/>	Parameter 10 <input type="text"/>

10. Example 7: Configure as a LoRaWAN gateway – Limited LoRaWAN mode

LoRaWAN mode:

Use LG01N / OLG01N as a LoRaWAN gateway* to forward packet to LoRaWAN IoT Server



Operate Principle:

- > LG01N/OLG01N running packet forward and will forward the uplink LoRa packet from end node to LoRaWAN server.
- > It will also forward downlink LoRa packet from LoRaWAN server to end node.
- > The end node can use OTAA or ABP mode in the LoRaWAN protocol.

Limitation:

- > The LG01 only support one LoRaWAN frequency for uplink. So the end node should be set to fix frequency.
- > If end node use multiply frequencies to transfer, The LG01 will only be able to receive the same frequency set in LG01N.

The LG01-N/LG02 is not recommend to be used a LoRaWAN gateway, Due to the limitation mentioned here:

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

If user can meet the limitation for the end node, user can refer this instruction:

http://wiki.dragino.com/index.php?title=Limitation_of_Single_Channel_Gateway#Set_Up_Dragino_End_Node_to_work_for_Single_Channel_Gateway_such_as_LG01.2FLG02 for how to set up the LG02 to use for LoRaWAN network.

This chapter describes how to use LG02 to work with [TTN LoRaWAN Server](#). The method to work with other LoRaWAN Server is similar.

11. More features

11.1 Remote Access

Remote Access Devices for management:

See

http://wiki.dragino.com/index.php?title=Main_Page#Remote_Access_Gateway_via_Reverse_SSH

11.2 More instructions

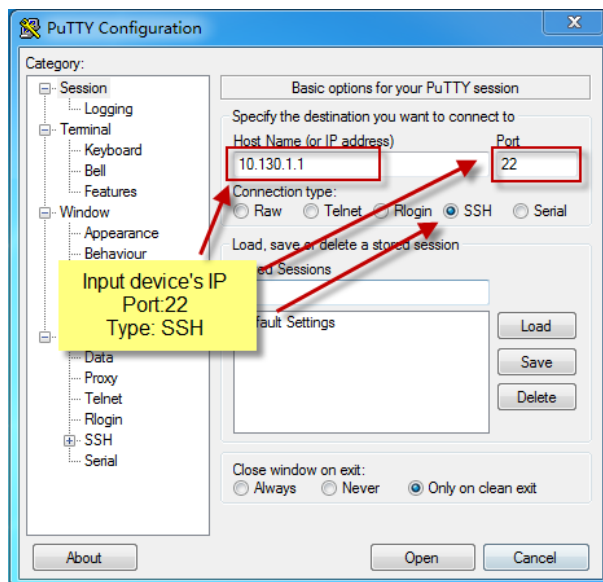
http://wiki.dragino.com/index.php?title=Main_Page#LoRa.2FLoRaWAN_Gateway_Instruction

12. Linux System

The LG02 bases on OpenWrt Linux System. It is open source, and user are free to configure and modify the inside Linux settings.

12.1 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:



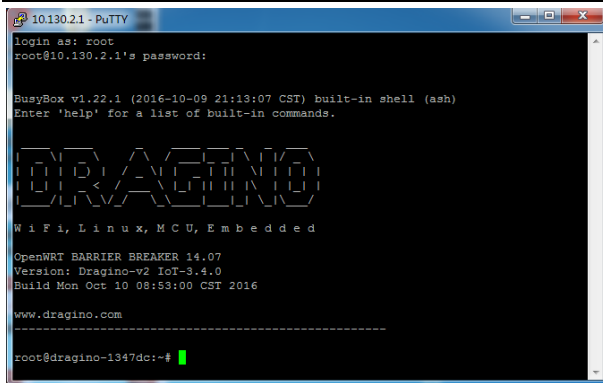
IP address: IP address of LG02

Port: 22 or 2222

User Name: **root**

Password: **dragino** (default)

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



```
1013021 - PuTTY
login as: root
root@10.130.2.1's password:

BusyBox v1.22.1 (2016-10-09 21:13:07 CST) built-in shell (ash)
Enter 'help' for a list of built-in commands.

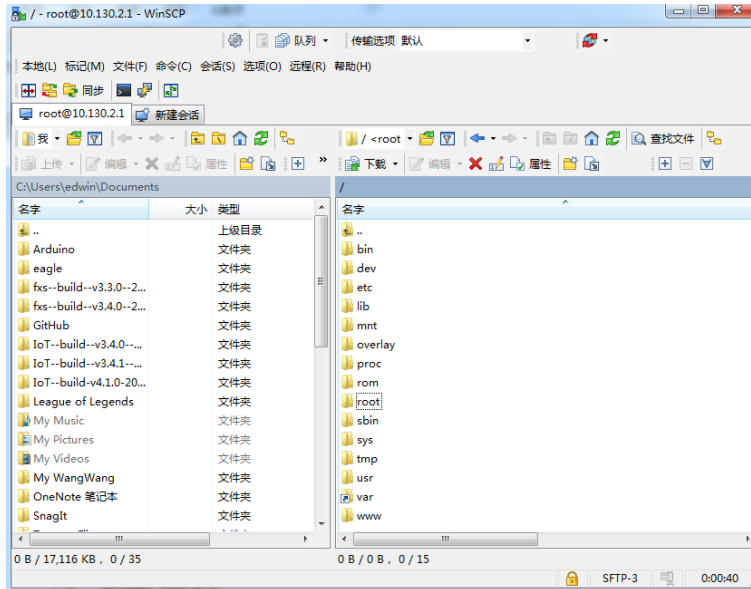
DRAGINO
W i F i , L i n u x , M C U , E m b e d d e d

OpenWRT BARRIER BREAKER 14.07
Version: Dragino-V2 IoT-3.4.0
Build Mon Oct 10 08:53:00 CST 2016

www.dragino.com
-----
root@dragino-1347dc:~#
```

12.2 Edit and Transfer files

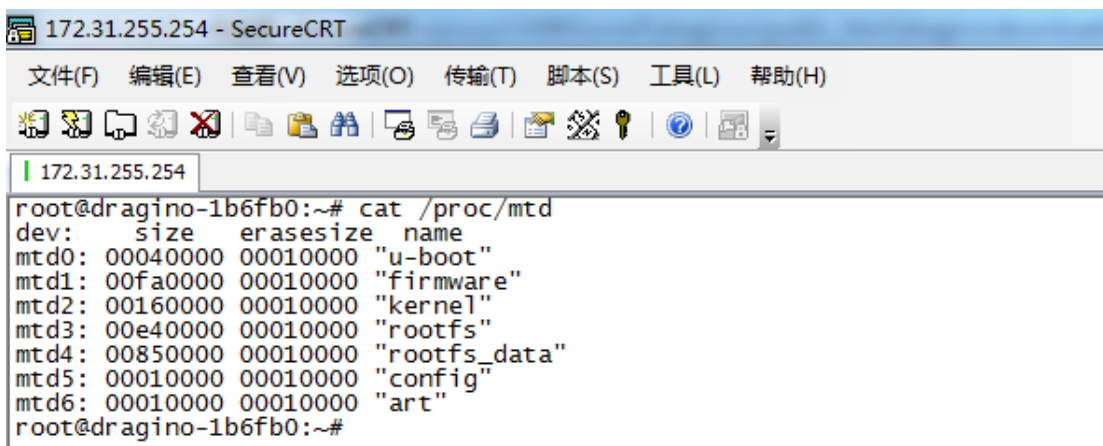
The LG02 support **SCP protocol** and has a built **SFTP server**. There are many ways to edit and transfer files using these two protocols. One of the easiest is through [WinSCP](#) utility. After access via WinSCP to the device, use can use a FTP alike window to drag / drop files to the LG02 or Edit the files directly in the windows. Screenshot is as below:



12.3 File System

The LG02 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.

Use cat /proc/mtd to see all blocks/partitions.



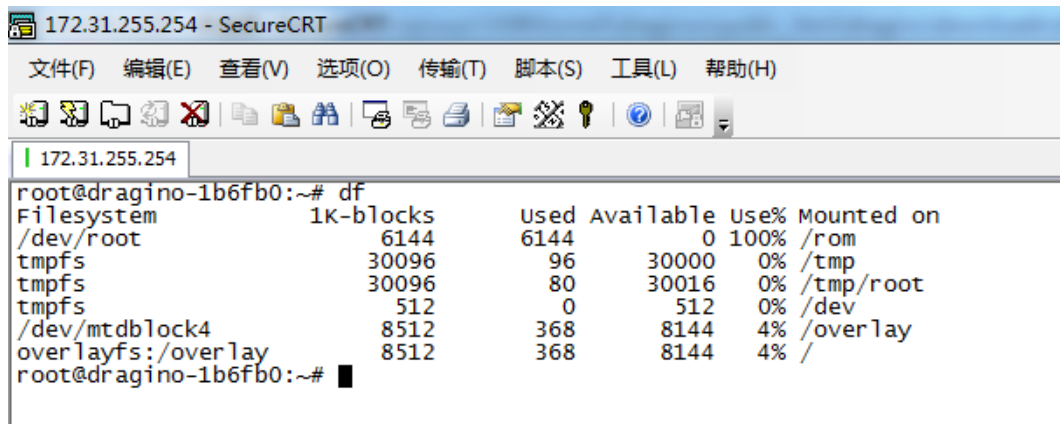
```

172.31.255.254 - 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)
| 172.31.255.254
root@dragino-1b6fb0:~# cat /proc/mtd
dev:   size  erasesize  name
mtd0: 00040000 00010000  "u-boot"
mtd1: 00fa0000 00010000  "firmware"
mtd2: 00160000 00010000  "kernel"
mtd3: 00e40000 00010000  "rootfs"
mtd4: 00850000 00010000  "rootfs_data"
mtd5: 00010000 00010000  "config"
mtd6: 00010000 00010000  "art"
root@dragino-1b6fb0:~#
    
```

- ✓ "u-boot" // for boot-loader
- ✓ "firmware" // combination of kernel & rootfs
- ✓ "kernel" // Linux kernel
- ✓ "rootfs" // Linux rootfs

- ✓ "rootfs_data" //inside rootfs, all data store here.
- ✓ "config" // a separate partition doesn't include file system
- ✓ "art" // radio data and board ID.

Use df command to see available flash & RAM:



```

172.31.255.254 - 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)
172.31.255.254
root@dragino-1b6fb0:~# df
Filesystem          1k-blocks      Used Available  Use% Mounted on
/dev/root            6144           6144         0 100% /rom
tmpfs                30096           96    30000     0% /tmp
tmpfs                30096           80    30016     0% /tmp/root
tmpfs                 512              0         512     0% /dev
/dev/mtdblock4       8512           368     8144     4% /overlay
overlayfs:/overlay  8512           368     8144     4% /
root@dragino-1b6fb0:~#

```

tmpfs 30096 96 30000 0% /tmp // RAM: reset after reboot,
 /dev/mtdblock4 8512 368 8144 4% /overlay //Flash: Remain after reboot

Reset to factory default:

mtdd erase rootfs_data -r

Except /tmp and /var. all data will be store in flash. /tmp and /var are store in RAM

12.4 Package maintain system

LG02 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 LG02 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.
```

13. Upgrade Linux Firmware

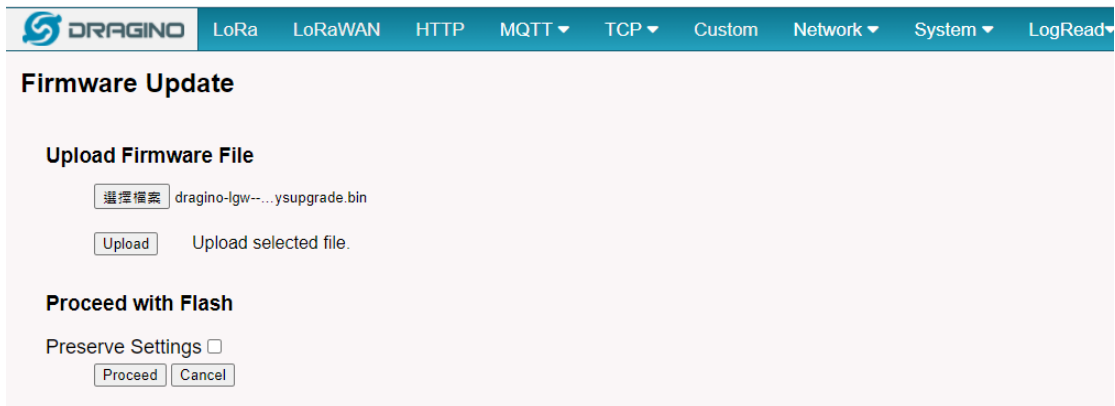
We keep improving the LG02 Linux side firmware for new features, bug fixes. The latest firmware can be found on [LG02 Firmware & release note](#)

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

13.1 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.



13.2 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.

14. FAQ

14.1 Why there is 433/868/915 version LoRa part?

Different country has different rules for the ISM band for using the LoRa. Although the LoRa chip can support a wide range of Frequency, we provide different version for best tune in the LoRa part. That is why we provide different version of LoRa.

14.2 What is the frequency range of LG02 LoRa part?

The chip used in the LoRa part is:

Version	LoRa IC	Support Frequency	Best Tune Frequency
433	Semtech SX1278	Band2(LF): 410 ~525Mhz Band3(LF): 137 ~175Mhz	433Mhz
868	Semtech SX1276	Band1(HF): 862 ~1020Mhz	868Mhz
915	Semtech SX1276	Band1(HF): 862 ~1020Mhz	915Mhz

User can set the LoRa within above frequency range in the software.

14.3 What does “Limited support on LoRaWAN”?

The base requirement to fully compatible with LoRaWAN protocol requires the gateway support 8 channels. The LG02 only support two channels and can only support limited LoRaWAN protocol. Below are limitations:

1/ It works only on one frequency at a time. It can support multiply end nodes, but all end nodes must transmit data at the same frequency so the LG02 can receive it. For example: if the End node transmits at 868.1Mhz, The LG02’s RX setting must be 868.1Mhz so to receive this packet.

2/ It works only for one DR at a time. DR specifies the Spreading Factor and Bandwidth. In LG02, even the rx frequency match , if DR doesn’t match, it still can’t get the sensor data.

3/ LoRaWAN compatible issue

In LoRaWAN protocol, the LoRaWAN end nodes send data in a hopping frequency. Since LG02 only supports one single frequency, it will only be able to receive the packets sent from the same radio parameters (frequency & DR) in LG02.

For example, in EU868, a standard LoRaWAN device may send the data in eight frequencies with different Frequency & SF, such as:

```
LMIC_setupChannel(0, 868100000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(1, 868300000, DR_RANGE_MAP(DR_SF12, DR_SF7B), BAND_CENTI); // g-band
LMIC_setupChannel(2, 868500000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(3, 867100000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(4, 867300000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(5, 867500000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
```

```
LMIC_setupChannel(6, 867700000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(7, 867900000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(8, 868800000, DR_RANGE_MAP(DR_FSK, DR_FSK), BAND_MILLI); // g2-band
```

So the LG02 will only be able to receive the 868100000, SF7 packet and will not receive others. Means only one packet will arrive the TTN server in every 8 packets sent from the LoRaWAN end node.

If user wants to receive all packets from LoRaWAN end node, user needs to set up the LoRaWAN node to send packets in a single frequency.

4/ Downlink & OTAA issue

According to the LoRaWAN class A spec, the end node will open two receive windows to get the message from LoRaWAN server for OTAA or downlink function. These two receive windows are quite short (milliseconds), if LoRa packet from the gateway can't reach End Node in the receive window time, the end node won't get the rx message and Downlink / OTAA won't work.

In our LoRaWAN example, the Arduino LMIC library is modified to enlarge the RX window to let OTAA & downlink work.

14.4 Can I develop my own application for LG02?

Yes, the fastest way to develop own software is through the SDK. The instruction is here:

https://github.com/dragino/openwrt_lede-18.06/blob/master/README.md#how-to-develop-a-c-software-before-build-the-image

14.5 Can I make my own firmware for LG02? Where can I find the source code of LG02?

Yes, User can make own firmware for LG02 for branding purpose or add customized application.

The LG02 source code and compile instruction can be found at:

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

14.6 Can I change the LoRa behavior of LG02?

Yes, Developer can change the LoRa control behavior of LG02. The source code of the LoRa

controller in LG02 is here: <https://github.com/dragino/dragino-packages/tree/lg02/lg02-pkt-fw>

And the compile method can refer: [Compile an application](#).

14.7 On OTAA mode, if I use the other frequency, how should I modify in the library?

In page [OTAA](#), We use frequency 904.6Mhz for sending. According to the LoRaWAN protocol, if the device Join the network successfully, the server will downlink the reply. The different intervals of frequency, the receiving frequency of the end node is also different.

Ex1: We use 914.2Mhz frequency.

We can input the command: `logread -f`

```

-----
Wed Sep 12 01:39:19 2018 daemon.info lg02_pkt_fw[14341]: INFO (json): [down] {"txpk":{"imne":false,"tmst":2831770149,"freq":927.5,"rfch":0,"powe":20,"modu":"LoRA","da
tr":"SF7Bw500","codr":"4/5","ipol":true,"size":17,"ncrc":true,"data":"IiadG+uy4yL7RAFx5HX0A="}}
Wed Sep 12 01:39:19 2018 daemon.info lg02_pkt_fw[14341]: SF=0x07
Wed Sep 12 01:39:19 2018 daemon.info lg02_pkt_fw[14341]: Transmit at SF7Bw500 on 927.500000.
Wed Sep 12 01:39:20 2018 daemon.info lg02_pkt_fw[14341]: SF=0x07
Wed Sep 12 01:39:20 2018 daemon.info lg02_pkt_fw[14341]: Transmit at SF7Bw500 on 927.500000.
Wed Sep 12 01:39:20 2018 daemon.info lg02_pkt_fw[14341]: Downlink done: count_us=2831770149
Wed Sep 12 01:39:21 2018 daemon.info lg02_pkt_fw[14341]: INFO (json): [down] {"txpk":{"imne":false,"tmst":2833763738,"freq":927.5,"rfch":0,"powe":20,"modu":"LoRA","da
tr":"SF7Bw500","codr":"4/5","ipol":true,"size":17,"ncrc":true,"data":"IG6NEMK9p5y1jF98P1xb2v1="}}
Wed Sep 12 01:39:21 2018 daemon.info lg02_pkt_fw[14341]: SF=0x07
Wed Sep 12 01:39:21 2018 daemon.info lg02_pkt_fw[14341]: Transmit at SF7Bw500 on 927.500000.
Wed Sep 12 01:39:22 2018 daemon.info lg02_pkt_fw[14341]: SF=0x07
Wed Sep 12 01:39:22 2018 daemon.info lg02_pkt_fw[14341]: Transmit at SF7Bw500 on 927.500000.
Wed Sep 12 01:39:22 2018 daemon.info lg02_pkt_fw[14341]: Downlink done: count_us=2833763738
Wed Sep 12 01:39:22 2018 daemon.info lg02_pkt_fw[14341]: Receive(HEX):40ad2a012680000010a2fd88ae57fa9451d478e5a1e693d8b
-----

```

We should modify this on `<lorabase.h>`, save and re-upload the sketch.

```

enum {
  US915_125kHz_UPFBASE = 914200000,
  US915_125kHz_UPFSTEP = 0,
  US915_500kHz_UPFBASE = 902320000,
  US915_500kHz_UPFSTEP = 0,
  US915_500kHz_DNFBASE = 927500000, //receive
  US915_500kHz_DNFSTEP = 0
};

```

For the result:

▲ 10:06:25	116	1	payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21
▲ 10:06:11	115	1	payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21
▲ 10:05:57	114	1	payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21
▲ 10:05:43	113	1	payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21
▲ 10:05:29	112	1	payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21

Ex2: We use 903.0Mhz frequency

We can input the command: logread -f

```
root@dragino-19a944:~# logread -f
wed Sep 12 02:11:31 2018 daemon.info lg02_pkt_fwd[20677]:
wed Sep 12 02:11:31 2018 daemon.info lg02_pkt_fwd[20677]: INFO (json): [down] [{"txpk":{"imme":false,"tmst":468442152,"freq":923.3,"rfch":0,"pove":20,"modu":"LORA","dat
r":{"SF7Bw500","codr":"4/5","tpol":true,"size":17,"hcr":true,"data":"lgkY0uey3XLdM7FSovbRBg="}}]
wed Sep 12 02:11:31 2018 daemon.info lg02_pkt_fwd[20677]: SF=0x07
wed Sep 12 02:11:31 2018 daemon.info lg02_pkt_fwd[20677]:
wed Sep 12 02:11:32 2018 daemon.info lg02_pkt_fwd[20677]: Transmit at SF7Bw500 on 923.300000.
wed Sep 12 02:11:32 2018 daemon.info lg02_pkt_fwd[20677]: SF=0x07
wed Sep 12 02:11:32 2018 daemon.info lg02_pkt_fwd[20677]:
wed Sep 12 02:11:32 2018 daemon.info lg02_pkt_fwd[20677]: Transmit at SF7Bw500 on 923.300000.
wed Sep 12 02:11:32 2018 daemon.info lg02_pkt_fwd[20677]: Downlink done: count_us=468442152
wed Sep 12 02:11:32 2018 daemon.info lg02_pkt_fwd[20677]:
wed Sep 12 02:11:32 2018 daemon.info lg02_pkt_fwd[20677]: Receive(HEX):00ac2301d07ed5b370907cb65d67c64a00cd3586bb5c88
wed Sep 12 02:11:36 2018 daemon.info lg02_pkt_fwd[20677]:
wed Sep 12 02:11:36 2018 daemon.info lg02_pkt_fwd[20677]: INFO (json): [up] [{"txpk":{"time":"2018-09-12T02:11:36.210520Z","tmst":472538265,"chan":0,"rfch":1,"freq":90
3.000000,"stat":1,"modu":"LORA","datr":{"SF7Bw125","codr":"4/5","tsnr":7.8,"rss1":-34,"size":23,"data":"AKWjAdB+1DNwKHy2XwFGsqDNVya7X1q="}}]
wed Sep 12 02:11:36 2018 daemon.info lg02_pkt_fwd[20677]:
```

▲ 10:13:33	1	1	payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21
▼ 10:13:21	0		
▲ 10:13:20	0	1	retry payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21
If join the network successfully, it will send a reply.			
+	10:13:15	dev addr: 26 01 20 71 app eui: 70 B3D5 7E D001 23AC dev eui: 00 4AC6 67 5D B67C 90	

We should modify this on <lorabase.h>, save and re-upload the sketch.

```
enum { US915_125kHz_UPFBASE = 903000000,
US915_125kHz_UPFSTEP = 0,
US915_500kHz_UPFBASE = 902320000,
US915_500kHz_UPFSTEP = 0,
US915_500kHz_DNFBASE = 923300000, //receive
US915_500kHz_DNFSTEP = 0
};
```

For the result:

▲ 10:16:57	16	1	payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21
▲ 10:16:43	15	1	payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21
▲ 10:16:29	14	1	payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21
▲ 10:16:15	13	1	payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21
▲ 10:16:01	12	1	payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21
▲ 10:15:47	11	1	payload: 68 65 6C 6C 6F 20 77 6F 72 6C 64 21

14.8 How can I reset the device to factory default?

User can reset the device to factory default in different ways:

Method 1:

Reset via Web UI. Click the button in Web UI --> System --> Back up / Flash firmware -> Perform Reset

Method 2:

Reset in Linux console, command is below:

```
root@dragino-1b8288:~# firstboot
```

This will erase all settings and remove any installed packages. Are you sure?

[N/y]

y

/dev/mtdblock4 is mounted as /overlay, only erasing files

```
root@dragino-1b8288:~# reboot
```

14.9 Can I control the LEDs?

Except the PWR LED and sensor LED, all other LEDs can be controlled by developer.

Control Globe LED:

ON: `echo 1 > /sys/class/leds/dragino2\:red\:wlan/brightness`

OFF: `echo 0 > /sys/class/leds/dragino2\:red\:wlan/brightness`

15. Trouble Shooting

15.1 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
```

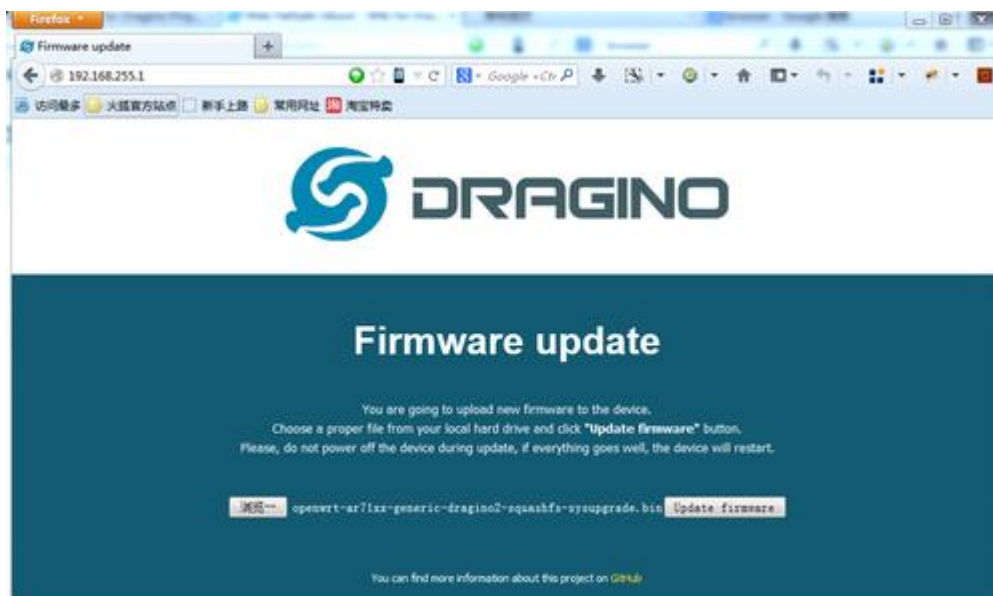
15.2 How to recover the LG02 if firmware crash

LG02 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:

1. Use a RJ45 cable to connect the PC to LG02's port directly.
2. Set the PC to ip 192.168.255.x, netmask 255.255.255.0
3. Pressing the toggle button and power on the device
4. All LEDs of the device will blink, release the toggle button after four blinks
5. 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.
6. Open 192.168.255.1 in web browser
7. Select a squashfs-sysupgrade type firmware and update firmware.



Note: If user sees all LEDs blink very fast in Step 5. This means the network connection is established. If in this case, PC still not able to see the web page, user can check:

- ✓ Try different browser.
- ✓ Check if your PC is in 192.168.255.x
- ✓ Check if you have connected two RJ45 cable to device, If so, remove the unused one

15.3 I configured LG02 for WiFi access and lost its IP. What to do now?



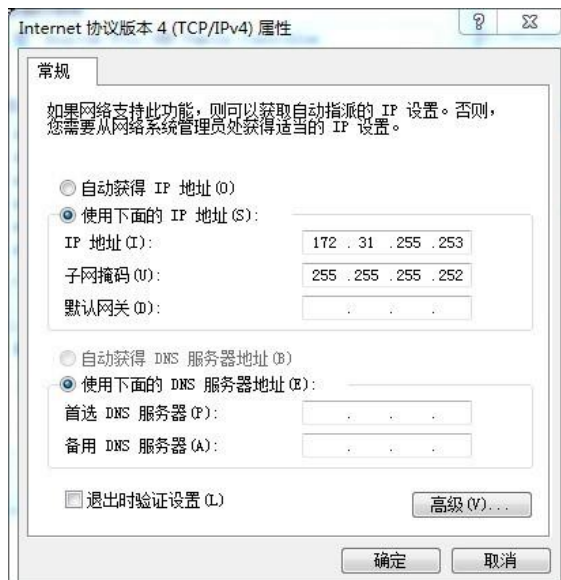
The LG01N and LG02 have a fall-back ip in its LAN port. This IP is always enabled so user can use fall back ip to access LG02 no matter what the WiFi IP is. The fall back ip is useful for connect and debug the unit.

(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 LG02'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 LG02 via Web or Console.

16. Order Info

PART:

- ✓ **Indoor version LG02-XXX-YYY**
- ✓ **Outdoor version: OLG02-XXX-YYY**

XXX: Frequency Band

- **433:** For Bands: EU433, CN470.
- **868:** For Bands: EU868, IN865.
- **915:** For Bands: US915, AU915, AS923, KR920.

YYY: 4G Cellular Option

- **EC25-E:** EMEA, Korea, Thailand, India.
- **EC25-A:** North America/ Rogers/AT&T/T-Mobile.
- **EC25-AU:** Latin America, New Zeland, Taiwan
- **EC25-J:** Japan, DOCOMO/SoftBank/ KDDI

More info about valid bands, please see [EC25-E product page](#).

17. Packing Info

Package Includes:

- ✓ LG02 or OLG02 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

18. 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

19. Reference

- ✧ Source code for LG02 LoRa Gateway
https://github.com/dragino/openwrt_lede-18.06

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

- ✧ Download of this manual or Update version
http://www.dragino.com/downloads/index.php?dir=UserManual/LG02_OLG02/

- ✧ LMIC library for Arduino LoRaWAN end device use with LG02.
<https://github.com/dragino/arduino-lmic>

- ✧ Hardware Source
LG02 = [IBB](#) + [LoRa G Dual](#)
OLG02= [PAN v2.0](#) + [LoRa G Dual](#)