WoMaster

User Manual

# IIoT Edge Computer Series

Aug.22.2024 V.1.1.3
(Firmware V0.6)

www.womaster.eu

# WoMaster

## IIoT Edge Computer Series

# User Manual



## About This Manual

This user manual is intended to guide a professional installer to install and to configure the IIoT Edge Computer Series. It includes procedures to assist you in avoiding unforeseen problems.

**NOTE:**

Only qualified and trained personnel should be involved with installation, inspection, and repairs of this router.

### Disclaimer

WoMaster reserves the right to make changes to this Manual or to the product hardware at any time without notice. Information provided here is intended to be accurate and reliable. However, it might not cover all details and variations in the equipment and does not claim to provide for every possible contingency met in the process of installation, operation, or maintenance. Should further information be required or should particular problem arise which are not covered sufficiently for the user's purposes, the matter should be referred to WoMaster. Users must be aware that updates and amendments will be made from time to time to add new information and/or correct possible unintentional technical or typographical mistakes. It is the user's responsibility to determine whether there have been any such updates or amendments of the Manual. WoMaster assumes no responsibility for its use by the third parties.

### WoMaster Online Technical Services

At WoMaster, you can use the online service forms to request the support. The submitted forms are stored in server for WoMaster team member to assign tasks and monitor the status of your service. Please feel free to write to help@womaster.eu if you encounter any problems.

# TABLE OF CONTENTS

# 1. OVERVIEW

## 1.1 INTRODUCTION

The WR302G-EC/WR312G-EC/WR322GR-EC edge computing platform is designed for embedded data acquisition applications. The computer comes with one or two software selectable RS-232/422/485 full-signal serial ports and 2 10/100/1000 Mbps Ethernet ports, as well as optional one or two Mini PCIe socket for Wi-Fi/Cellular modules. These versatile communication capabilities let users efficiently adapt the WR302G-EC/WR312G-EC/WR322GR-EC to a variety of complex communications solutions. The WR302G-EC/WR312G-EC/WR322GR-EC is built around a MT7621 MIPS-based processor that is widely applicable to a variety of industrial solutions.

The WR322GR-EC-LoRaWAN is a programmable cellular or Ethernet gateway for LoRaWAN communication. It supports the LoRAWAN protocol for long-range wireless connection to multiple LoRaWAN nodes. The WR322GR-EC-LTELoRaWAN gateway converts LoRaWAN™ data to MQTT and transmits to the cloud through the LTE network. The gateway comes with two software-selectable RS-232/422/485 Modbus full-signal serial ports and two 10/100/1000 Mbps Ethernet ports. The built-in Node-RED flow-based programming in the gateway provides a reliable and secure gateway for data acquisition and processing at field sites as well as a userfriendly communication platform for many other large-scale deployments. Combining with the new LoRaWAN controller LR140, Cloud platform ThingsMaster, and various environmental sensors, WoMaster presents complete IoT Environment Monitoring applications.

## 1.2 MODEL NAME

| Model Name | Description |
|---|---|
| **WR302G-EC** | Industrial Edge Computing Secure Serial Server, 2GbE+2COM, USB, SD |
| **WR312G-WLAN-EC** | Industrial Secure Wireless Edge Computer, 2GbE+2COM, USB, SD, 802.11ac/n WLAN |
| **WR312G-LTE-E-EC** | Industrial Secure Cellular Edge Computer, 2GbE+2COM, USB, SD, LTE-E, 1SIM, FDD B1/3/5/7/8/20, TDD B38/40/41 |
| **WR322GR-WLAN+LTE-E-EC** | Industrial Secure Cellular Edge Computer, 2GbE+2COM, USB, SD, 802.11ac/n WLAN, LTE-E, GPS, 2SIM, FDD B1/3/5/7/8/20, TDD B38/40/41 |
| | *Embedded SIM by request<br>*LTE-AU/LTE-U Cat.4 by request<br>*LTE-AP/LTE-U Cat.6 by request<br>*Dual LTE concurrent by request<br>*GPS support for WR312G-LTE-E-EC series by request |
| **WR312GR-EC-LORAWAN-(Region Code)** | Industrial LoRaWAN Gateway, 2GbE+2COM, LoRaWAN Region |
| **WR322GR-EC-LTE-LORAWAN-(Region Code)** | Industrial LoRaWAN Gateway, 2GbE+2COM, LTE 2SIM, FDD B1/3/7/8/20/28A, LoRaWAN Region |

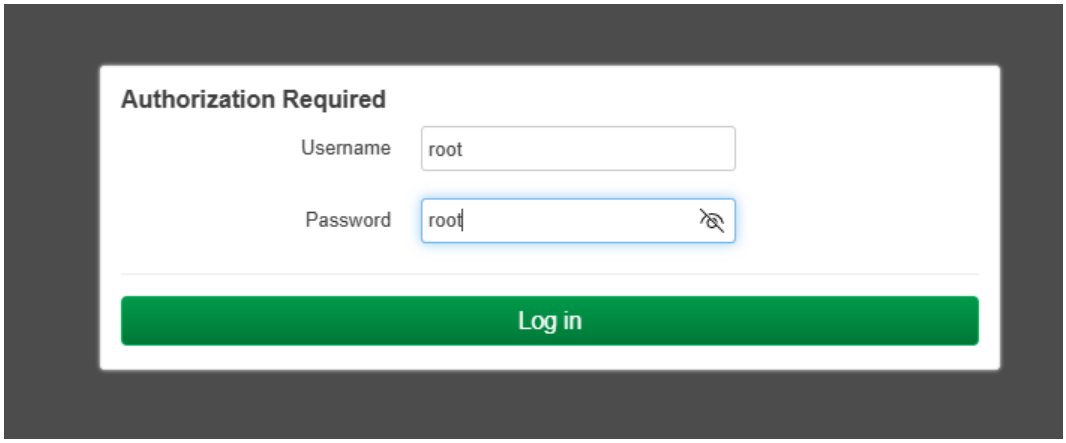
# 2. WEB MANAGEMENT CONFIGURATION

To access the management interface, WoMaster router has two ways access mode through a network; they are web management and telnet management. Web interface management is the most common way and the easiest way to manage a network, through web interface management, a router interface offering status information and a subset of device commands through a standard web browser. If the network is down, another alternative to access the management interface can be used. The alternative way is by using telnet management which is offer configuration way through CLI Interface. This manual describes the procedures for Web Interface and how to configure and monitor the managed router only.

***PREPARATION FOR WEB INTERFACE MANAGEMENT***

WoMaster provides Web interface management that allows user through standard web-browser such as Microsoft Internet Explorer, or Mozilla, or Google Chrome, to access and configure the router management on the network.

1. Plug the DC power to the router and connect router to computer.
2. Check the router default IP address in label: **192.168.1.1**. (**Note:** The default IP may change with different version, please see the sticker on the outside of the device.)
3. Check that PC has an IP address on the same subnet as the router. For example, the PC and the router are on the same subnet if they both have addresses that start 192.168.1.x (Ex: **192.168.1.2)**. The subnet mask is 255.255.255.0.
4. Open command prompt and ping **192.168.1.1** to verify that the router is reachable.
5. Launch the web browser (Internet Explorer or Mozilla Firefox or Google Chrome) on the PC.
6. Type **http://192.168.1.1** (or the IP address of the router). And then press **Enter** and the login page will appear.
7. Type user name and password. The default user name: **root** and password: **root**. Then click **Log in**.




**Note:** The default password was changed from no password to root after version v0.6.

| Firmware Version | User Name/Default Password | Default IP |
|---|---|---|
| Before V0.5 | root / **no password** | 192.168.1.1 |
| V0.6 & later | root / **root** | 192.168.1.1 |
| V0.7 & later | root / **root** | 192.168.10.1 |

# 3. GETTING START

In this chapter, we describe how to configure the basic settings WoMaster's Edge computers.

The following topics are covered in this chapter:

- **Connecting to the Edge Computer**
  - Connecting Through the SSH Console
- **Network Settings**
  - Configuring Network Setting over the Network
- **Determining Available Drive Space**
- **Shutting Down the Device**

## 3.1 CONNECTING TO EDGE COMPUTER

You will need another computer to connect to the Arm-based computer and log on to the command line interface.

There are two ways to connect: through serial console cable or through Ethernet cable.

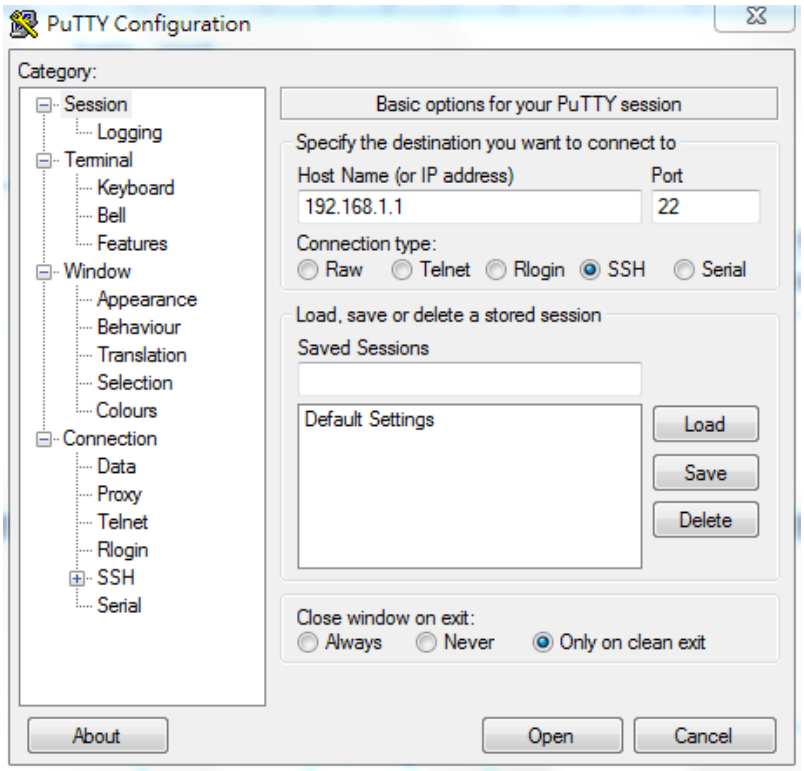
The default login username and password are:

login : root

Password: (no password)

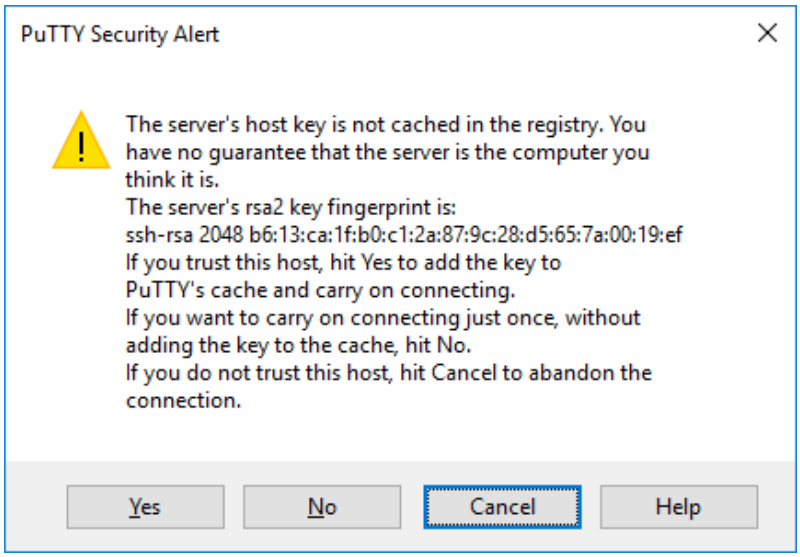
### 3.1.1 SSH CONSOLE

The Edge Computer supports an SSH Console by default to offer users with better security options. On PC, click on the link putty to download PuTTy(freeware) and set up an SSH console for EC Series in a Windows environment. The following figure shows an example of the configuration that is required.

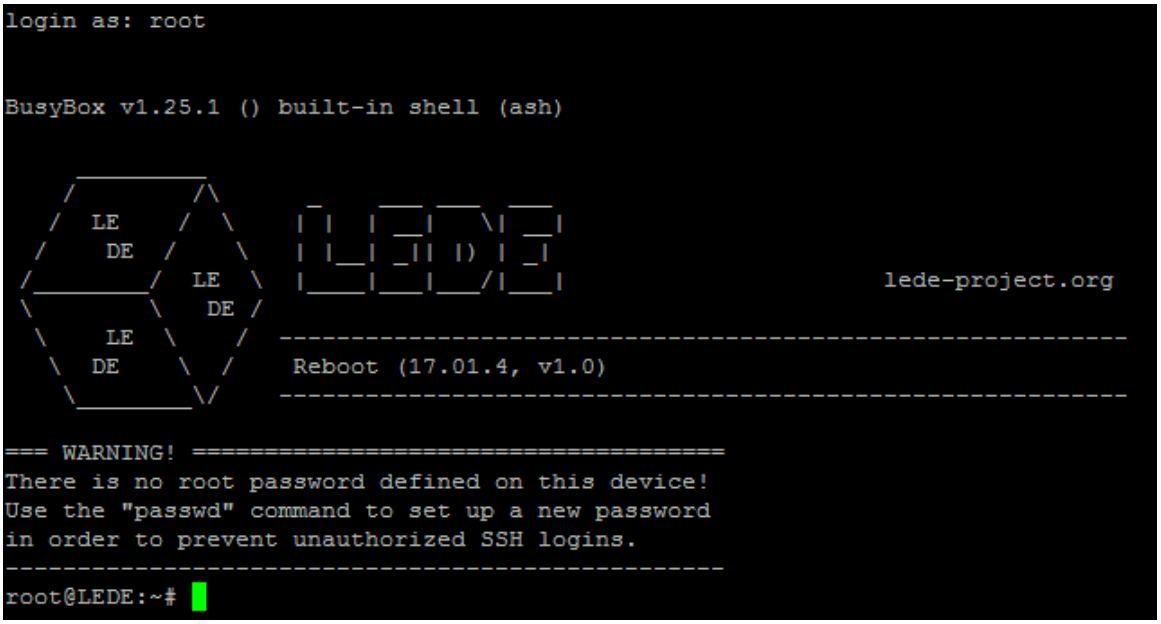



Windows PuTTy setting

Click Yes to add the key to PuTTY's cache and carry on connecting.




Then Login with the Username and Password. (Username: root, Password: admin)



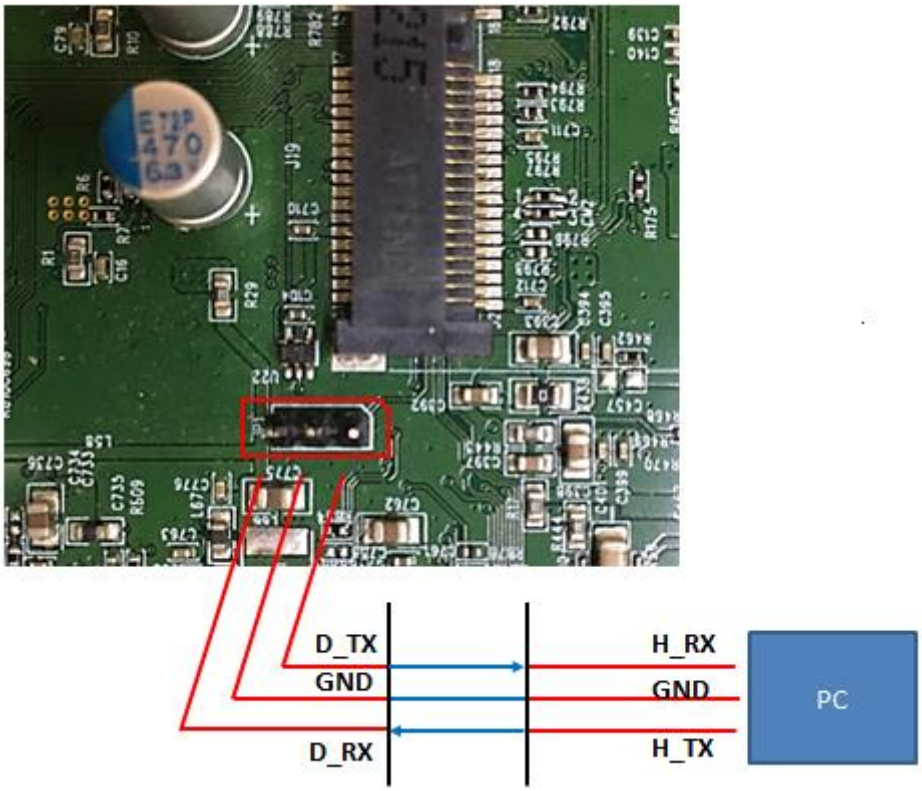

The MIPS-based computer supports SSH connections over an Ethernet network. Use the following default IP addresses to connect to the MIPS-based computer.

**Connecting through the SSH Console**

| Port | Linux | Bridge | Description | Default IP |
|---|---|---|---|---|
| Port 1 | eth0 | br-wan | WAN | DHCP |
| Port 2 | eth1 | br-lan | LAN | 192.168.1.1 |

### 3.1.2 TTL UART CONSOLE

For this connection user needs to open the box and using a suitable cable, such as the USB TTL Serial cable, user can connect it to the PC and using some simple terminal software set to 57600-8-N-1 use the command line interface to the WR322GR-EC in the same way as if user uses a keyboard and screen connected to it.




**Note:** The peripheral works with 3.3V logic levels, wiring to wrong voltage or wrong pin will damage the main board.

User can use any kind of terminal emulator software, to get into the console interface.

## 3.2 CONFIGURE NETWORK SETTING

The central network configuration is located in the file /etc/config/network. This configuration file is responsible for interface configurations and network routes. After editing and saving /etc/config/network you need to execute

```
/etc/init.d/network reload
```

To stop and restart the network before any changes take effect. Rebooting the router is not necessary

.

1. Show current network setting with "**uci show network**"

```
root@LEDE:~# uci show network
network.loopback=interface
network.loopback.ifname='lo'
network.loopback.proto='static'
network.loopback.ipaddr='127.0.0.1'
network.loopback.netmask='255.0.0.0'
network.globals=globals
network.globals.ula_prefix='fd99:4997:04c3::/48'
network.lan=interface
network.lan.type='bridge'
network.lan.ifname='eth1'
network.lan.proto='static'
network.lan.netmask='255.255.255.0'
network.lan.ip6assign='60'
network.lan.ipaddr='192.168.10.3'
network.lan.gateway='192.168.10.254'
network.wan=interface
network.wan.ifname='eth0'
network.wan.proto='dhcp'
network.wan.type='bridge'
network.wan6=interface
network.wan6.ifname='eth0'
```

If you only want to show lan's setting, you can type "**uci show network.lan**"

```
root@LEDE:~# uci show network.lan
network.lan=interface
network.lan.type='bridge'
network.lan.ifname='eth1'
network.lan.proto='static'
network.lan.netmask='255.255.255.0'
```

```
network.lan.ip6assign='60'
network.lan.ipaddr='192.168.10.3'
network.lan.gateway='192.168.10.254'
```

2. To change lan's ip address to 192.168.10.4

```
root@LEDE:~# uci set network.lan.ipaddr=192.168.10.4
```

You can check the config again with "uci get"

```
root@LEDE:~# uci get network.lan.ipaddr
192.168.10.4
```

To apply the network settings

```
/etc/init.d/network reload
```

To save the network settings

```
root@OpenWrt:~# uci commit
```

Reference

https://openwrt.org/docs/guide-user/base-system/basic-networking

https://oldwiki.archive.openwrt.org/doc/uci/network

### 3.2.1 MODIFYING NETWORK SETTINGS OVER THE NETWORK

Same the previous section, IP settings can be modified over the network, too. There is another way to change the IP address without modifying the file /etc/config/network, but the new settings will **not** be saved to the flash disk.

For example, type the command #**ifconfig eth1 192.168.10.4** to change the IP address of LAN interface to 192.168.10.4.

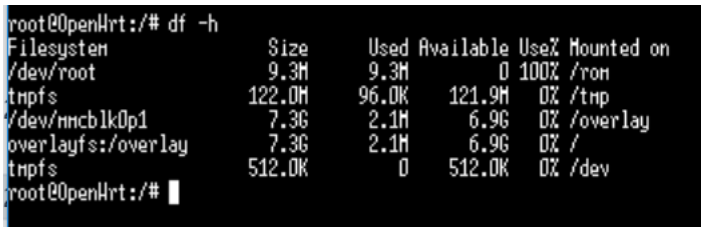
```
root@LEDE:~# ifconfig eth1 192.168.10.4
root@LEDE:~# ifconfig
br-lan    Link encap:Ethernet  HWaddr 94:66:E7:00:0D:A7
          inet addr:192.168.10.4  Bcast:192.168.10.255  Mask:255.255.255.0
          inet6 addr: fe80::9666:e7ff:fe00:da7/64 Scope:Link
          inet6 addr: fdf0:7b1a:a679::1/60 Scope:Global
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2178 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1803 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:459387 (448.6 KiB)  TX bytes:110566 (107.9 KiB)

eth0      Link encap:Ethernet  HWaddr 94:66:E7:00:0D:A6
          inet addr:192.168.10.5  Bcast:192.168.10.255  Mask:255.255.255.0
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:643 errors:0 dropped:0 overruns:0 frame:0
```

```
          TX packets:65 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:147750 (144.2 KiB)  TX bytes:20270 (19.7 KiB)
          Interrupt:4

eth1      Link encap:Ethernet  HWaddr 94:66:E7:00:0D:A7
          inet addr:192.168.10.4  Bcast:192.168.10.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:7385 errors:0 dropped:0 overruns:0 frame:0
          TX packets:6956 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1580144 (1.5 MiB)  TX bytes:559221 (546.1 KiB)
          Interrupt:5

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:2905 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2905 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:255279 (249.2 KiB)  TX bytes:255279 (249.2 KiB)

wlan0     Link encap:Ethernet  HWaddr 04:F0:21:3B:8A:04
          inet addr:192.168.1.249  Bcast:192.168.1.255  Mask:255.255.255.0
          inet6 addr: fe80::6f0:21ff:fe3b:8a04/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2888 errors:0 dropped:0 overruns:0 frame:0
          TX packets:39 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:455800 (445.1 KiB)  TX bytes:4188 (4.0 KiB)
```

**Network Setting over the Network**

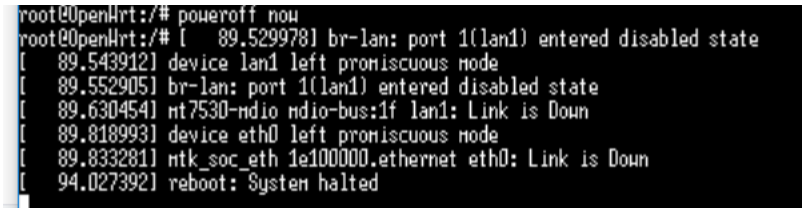
## 3.3 DETERMINING AVAILABLE DRIVE SPACE

To determine the amount of available drive space, use the **df** command with the **–h** parameter. The system will return the amount of drive space broken down by file system. Here is an example:




## 3.4 SHUTTING DOWN THE DEVICE

To shut down the device, disconnect the power source to the computer. When the computer is powered off, main components such as the CPU, RAM, and storage devices are powered off. You can use the command **poweroff** to close all software running on the device and halt the system. However, main components such as the CPU, RAM, and storage devices will continue to be powered after you run this command.



# 4. SYSTEM FEATURE

This chapter includes information about version control, deployment, updates, and peripherals. The information in this chapter will be particularly useful when you need to run the same application.

## 4.1 SYSTEM VERSION

**Querying the Firmware Version**

To check the edge computer's firmware version, type:

```
root@OpenWrt:/# cat /etc/openwrt_version
v0.2
```

## 4.2 CURRENT RUNNING PROCESS

Type the command "**ps**" to list all processes currently running.

```
root@OpenWrt:/# ps
  PID USER       VSZ STAT COMMAND
    1 root      1968 S    /sbin/procd
    2 root         0 SW   [kthreadd]
    3 root         0 IW<  [rcu_gp]
    4 root         0 IW<  [rcu_par_gp]
    5 root         0 IW<  [slub_flushwq]
    6 root         0 IW<  [netns]
    9 root         0 IW   [kworker/u8:0-ev]
   10 root         0 IW<  [mm_percpu_wq]
   11 root         0 SW   [rcu_tasks_trace]
   12 root         0 SW   [ksoftirqd/0]
   13 root         0 IW   [rcu_sched]
   14 root         0 SW   [migration/0]
   15 root         0 SW   [cpuhp/0]
   16 root         0 SW   [cpuhp/1]
   17 root         0 SW   [migration/1]
   18 root         0 SW   [ksoftirqd/1]
   21 root         0 SW   [cpuhp/2]
   22 root         0 SW   [migration/2]
   23 root         0 SW   [ksoftirqd/2]
   26 root         0 SW   [cpuhp/3]
   27 root         0 SW   [migration/3]
```

```
 28 root      0 SW    [ksoftirqd/3]
 31 root      0 IW<   [inet_frag_wq]
 33 root      0 IW    [kworker/1:1-eve]
 34 root      0 SW    [oom_reaper]
 35 root      0 IW<   [writeback]
 36 root      0 SW    [kcompactd0]
 41 root      0 IW<   [pencrypt_serial]
 42 root      0 IW<   [pdecrypt_serial]
 54 root      0 IW<   [kblockd]
 55 root      0 IW<   [blkcg_punt_bio]
 56 root      0 SW    [watchdogd]
 57 root      0 IW    [kworker/3:1-mm_]
 58 root      0 IW    [kworker/u8:1-ev]
 69 root      0 SW    [kswapd0]
 70 root      0 IW<   [kworker/0:1H-kb]
 72 root      0 IW<   [kthrotld]
118 root      0 IW    [kworker/0:4-eve]
120 root      0 IW    [kworker/0:5-eve]
128 root      0 SW    [spi0]
219 root      0 SW    [napi/mtk_eth-5]
220 root      0 SW    [napi/mtk_eth-6]
245 root      0 IW<   [mld]
246 root      0 IW    [kworker/2:4-eve]
247 root      0 IW<   [ipv6_addrconf]
248 root      0 IW<   [kworker/2:1H-kb]
249 root      0 IW    [kworker/2:5-mm_]
250 root      0 IW<   [dsa_ordered]
252 root      0 SW    [irq/23-mt7530]
274 root      0 IW    [kworker/1:3-eve]
276 root      0 IW<   [kworker/3:1H-mm]
325 root      0 IW    [kworker/3:2-usb]
356 root      0 IW<   [kworker/2:2H-mm]
357 root      0 IW<   [kworker/1:1H-kb]
359 root      0 IW<   [mmc_complete]
471 root      0 SW    [jbd2/mmcblk0p1-]
472 root      0 IW<   [ext4-rsv-conver]
568 ubus   1512 S     /sbin/ubusd
569 root   1384 S     /bin/ash --login
```

```
  571 root      0 IW<   [kworker/0:2H-mm]
  610 root   1216 S     /sbin/urngd
  711 root      0 IW<   [rpciod]
  712 root      0 IW<   [kworker/u9:0]
  713 root      0 IW<   [xprtiod]
  759 root      0 IW<   [nfsiod]
  903 root      0 IW<   [cfg80211]
 1138 logd   1488 S     /sbin/logd -S 64
 1192 root   3584 S     /sbin/rpcd -s /var/run/ubus/ubus.sock -t 30
 1265 root      0 IW<   [kworker/3:2H]
 1476 root   1280 S     /usr/sbin/dropbear -F -P /var/run/dropbear.1.pid -p
 1641 root   2128 S     /sbin/netifd
 1809 root   1876 S     /usr/sbin/odhcpd
 1936 root   2904 S     /usr/sbin/uhttpd -f -h /www -r OpenWrt -x /cgi-bin -
 2041 root   1152 S     xl2tpd -D -l -p /var/run/xl2tpd.pid
 2560 root  11460 S     /usr/lib/ipsec/charon
 2845 root   2916 S     {ntpd} /sbin/ujail -t 5 -n ntpd -U ntp -G ntp -C /et
 2873 ntp    1380 S     /usr/sbin/ntpd -n -N -S /usr/sbin/ntpd-hotplug -p 0.
 2955 root   1676 S     /usr/sbin/ser2net -n -c /tmp/ser2net.conf
 3071 root   2916 S     {dnsmasq} /sbin/ujail -t 5 -n dnsmasq -u -l -r /bin/
 3076 dnsmasq  1732 S     /usr/sbin/dnsmasq -C /var/etc/dnsmasq.conf.cfg01411c
 3414 root   2048 S     /usr/lib/ipsec/starter --daemon charon --nofork
 3415 root  11460 S     /usr/lib/ipsec/charon
 3463 root   1224 S     odhcp6c -s /lib/netifd/dhcpv6.script -P0 -t120 wan
 3464 root   1380 S     udhcpc -p /var/run/udhcpc-wan.pid -s /lib/netifd/dhc
 3473 root      0 IW<   [kworker/1:0H]
 4450 root   1388 R     ps
root@OpenWrt:/#
```

## 4.3 SETTING SYSTEM TIME

The edge computer has two time settings. One is the system time, and the other is the RTC (Real Time Clock) time kept by the hardware.

Use the **#date** command to query the current system time or set a new system time.

```
root@LEDE:~# date "2018-12-24 10:28" – yyyy-mm-dd hh:mm
Mon Dec 24 10:28:00 UTC 2018
mm = Month
```

dd = Date

hh:mm = hour and minute

yyyy = Year

Use **#hwclock** to query the current RTC time

Use the following command to set system time from hardware clock:

```
root@LEDE:~# hwclock -w
```

The following figure illustrates how to update the system time and set the RTC time.

```
root@LEDE:~# date "2018-12-24 10:57"
Mon Dec 24 10:57:00 UTC 2018
root@LEDE:~# hwclock -w
root@LEDE:~# date
Mon Dec 24 10:57:09 UTC 2018
```

**Setting the Time Manually**

Use root@LEDE:~# hwclock –h to see the help function

Usage:

hwclock [function] [option...]

Query or set the hardware clock.

Functions:

-h, --help show this help text and exit

-r, --show read hardware clock and print result

--get read hardware clock and print drift corrected result

--set set the RTC to the time given with --date

-s, --hctosys set the system time from the hardware clock

-w, --systohc set the hardware clock from the current system time

--systz set the system time based on the current timezone

--adjust adjust the RTC to account for systematic drift since the clock was last set or adjusted

-c, --compare periodically compare the system clock with the CMOS clock

--getepoch print out the kernel's hardware clock epoch value

--setepoch set the kernel's hardware clock epoch value to the value given with --epoch

--predict predict RTC reading at time given with --date

-V, --version display version information and exit

Options:

| | | |
|---|---|---|
| -u, | --utc | the hardware clock is kept in UTC |
| | --localtime | the hardware clock is kept in local time |
| -f, | --rtc <file> | special /dev/... file to use instead of default |
| | --directisa | access the ISA bus directly instead of /dev/rtc |
| | --badyear | ignore RTC's year because the BIOS is broken |
| | --date <time> | specifies the time to which to set the hardware clock |
| | --epoch <year> | specifies the year which is the beginning of the hardware clock's epoch value |
| | --update-drift | update drift factor in /etc/adjtime (requires --set or --systohc) |
| | --noadjfile | do not access /etc/adjtime; this requires the use of either --utc or --localtime |
| | | --adjfile <file> specifies the path to the adjust file; the default is /etc/adjtime |
| | --test | do not update anything, just show what would happen |
| -D, | --debug | debugging mode |

## 4.4 ADJUST SYSTEM TIME

NTP provides time synchronization based on a network of reference clocks located around the world. OpenWrt supports both NTP client protocol (to synchronize local time with a distant clock) and NTP server protocol (to deliver time to your local network).

The ntp configuration is located in system uci subsystem, and found in file /etc/config/system.

### 4.4.1 TIMESERVER SECTION

The NTP configuration is found in timeserver section of system uci subsystem.

```
root@LEDE:/# uci show system.ntp
system.ntp=timeserver
system.ntp.enabled='1'
system.ntp.enable_server='0'
system.ntp.server='0.lede.pool.ntp.org' '1.lede.pool.ntp.org' '2.lede.pool.ntp.org' '3.lede.pool.ntp.org'
```

By default, NTP client is enabled

```
root@LEDE:/# cat /etc/config/system
…
config timeserver 'ntp'
        option enabled '1'                      # NTP client is enabled
        option enable_server '0'
        list server '0.lede.pool.ntp.org'
        list server '1.lede.pool.ntp.org'
        list server '2.lede.pool.ntp.org'
        list server '3.lede.pool.ntp.org'
```

### 4.4.2 NTP CLIENT

If you only wish to synchronize your clock when the device boots up, you can use **ntpclient**. This may be appropriate for some devices which are frequently rebooted and only require infrequent synchronization.

Using **ntpclient** at boot time is also a good idea for devices that run **ntpd**. The **ntpd** program changes the clock gradually, whereas **ntpclient** sets the clock, no matter how great the difference between a device's current clock setting and the correct time.

The Edge Computer has a built-in NTP (Network Time Protocol) client that is used to initialize a time request to a remote NTP server.

Use **#ntpd** to update the system time.

```
root@WR322V3-EC:~# ntpd -n -N -p ntp.ntsc.ac.cn
ntpd: setting time to 2024-05-23 06:37:55.903680 (offset +170796937.399431s)
```

Visit http://www.ntp.org for more information about NTP and NTP server addresses.

> **NOTE**
>
> Before using the NTP client utility, check your IP and DNS settings to make sure that an Internet connection is available.

### 4.4.2 NTP SERVER

To start the server, execute the command:

```
root@LEDE:~# ntpd -l
```

## 4.5 SETTING THE TIMEZONE AND HOSTNAME

To configure the embedded computer's **Timezone,** user can use the **TZ** variable.

The format of the TZ environment variable looks like this:

TZ=*<Value>HH[:MM[:SS]][daylight[HH[:MM[:SS]]][,start date[/starttime], enddate[/endtime]]]*

Here are some possible settings for the North American Eastern time zone:

1. **TZ=EST5EDT**
2. **TZ=EST0EDT**
3. **TZ=EST0**

In the first case, the reference time is GMT and the stored time values are correct worldwide. A simple change of the TZ variable can print the local time correctly in any time zone. In the second case, the reference time is Eastern Standard Time and the only conversion performed is for Daylight Saving Time. Therefore, there is no need to adjust the hardware clock for Daylight Saving Time twice per year. In the third case, the reference time is always the time reported. You can use this option if the hardware clock on your machine automatically adjusts for Daylight Saving Time or you would like to manually adjust the hardware time twice a year.

```
root@LEDE:~# TZ=EST5EDT
root@LEDE:~# export TZ
root@LEDE:~# date
Fri Dec 28 03:32:12 EDT 2018
root@LEDE:~#
```

The system UCI subsystem configuration file is located in ***/etc/config/system***.

The *system* section contains settings that apply to the most basic operation of the system, such as the hostname, the time zone, and how and where to write logging information to. The default settings are:

```
root@LEDE:/# uci show system
system.@system[0]=system
system.@system[0].hostname='LEDE'
system.@system[0].timezone='UTC'
system.@system[0].ttylogin='0'
system.@system[0].log_size='64'
system.@system[0].urandom_seed='0'
system.ntp=timeserver
system.ntp.enabled='1'
system.ntp.enable_server='0'
system.ntp.server='0.lede.pool.ntp.org' '1.lede.pool.ntp.org' '2.lede.pool.ntp.org'
'3.lede.pool.ntp.org'
```

**Change the system's timezone**

```
root@LEDE:/# uci set system.@system[0].timezone="EAT-3"
```

**Change the system's hostname**

root@LEDE:/# uci set system.@system[0].hostname=WR322

**Apply the system settings**

root@LEDE:/# /etc/init.d/system reload

**Save the changes to startup configuration**

root@LEDE:/# uci commit system

```
root@LEDE:~# uci set system.@system[0].hostname=WR322
root@LEDE:~# /etc/init.d/system reload
root@WR322:~# uci commit system
```

**Link Reference:** https://openwrt.org/docs/guide-user/base-system/system_configuration

The following table lists other possible values for the TZ environment variable: **Hours from Greenwich Mean Time (GMT)**

| | Value | Description |
|---|---|---|
| 0 | GMT | Greenwich Mean Time |
| +1 | ECT | European Central Time |
| +2 | EET | European Eastern Time |
| +2 | ART | |
| +3 | EAT | Saudi Arabia |
| +3.5 | MET | Iran |
| +4 | NET | |
| +5 | PLT | West Asia |
| +5.5 | IST | India |
| +6 | BST | Central Asia |
| +7 | VST | Bangkok |
| +8 | CTT | China |
| +9 | JST | Japan |
| +9.5 | ACT | Central Australia |
| +10 | AET | Eastern Australia |
| +11 | SST | Central Pacific |
| +12 | NST | New Zealand |
| -11 | MIT | Samoa |
| -10 | HST | Hawaii |
| -9 | AST | Alaska |
| -8 | PST | Pacific Standard Time |
| -7 | PNT | Arizona |
| -7 | MST | Mountain Standard Time |

| | | |
|---|---|---|
| -6 | CST | Central Standard Time |
| -5 | EST | Eastern Standard Time |
| -5 | IET | Indiana East |
| -4 | PRT | Atlantic Standard Time |
| -3.5 | CNT | Newfoundland |
| -3 | AGT | Eastern South America |
| -3 | BET | Eastern South America |
| -1 | CAT | Azores |

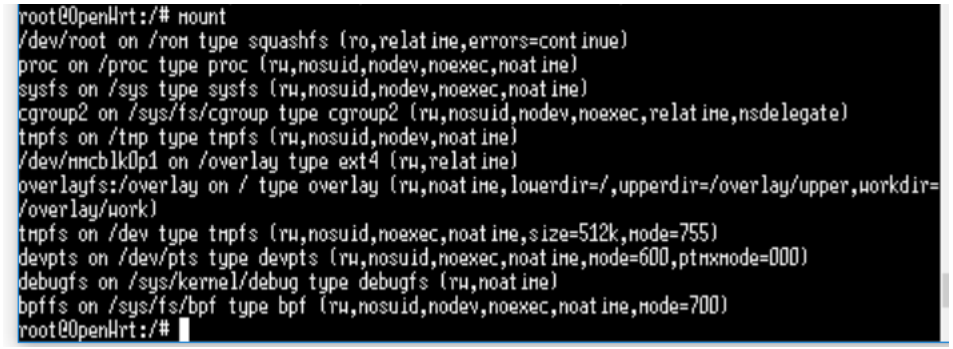
## 4.6 CONNECT PERIPHERALS

This chapter is included more information on the MIPS-based computer's peripherals, such as the serial interface, storage, diagnostic LEDs, and the cellular module. The instructions in this chapter cover all functions supported in WoMaster's Edge computers. Before referring to the sections in this chapter, make sure that they are applicable to and are supported by the hardware specification of your MIPS-based computer.

While plug-in a USB mass storage or a SD card, use **dmesg** command can help showing USB-storage device status.


**usb-storage device scan status**

To check the external storage, just use ***mount*** command as following:




To manually mount a usb-storage, execute

```
root@LEDE:~# mount <device path> <mount path>
```

To manually un-mount the usb-storage, execute

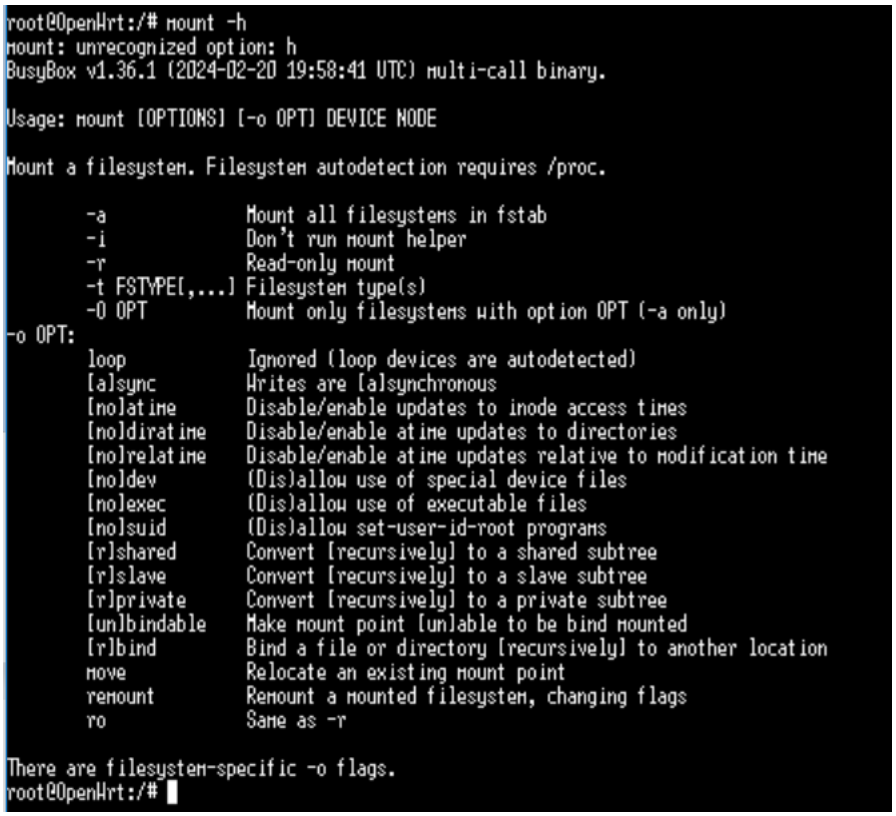
```
root@LEDE:~# umount <mount path>
```

**NOTE**

To be able to unmount a device, you have to close all the open files in it.

Type **sync** can help commits all pending writes, which can then be removed in a safe way.

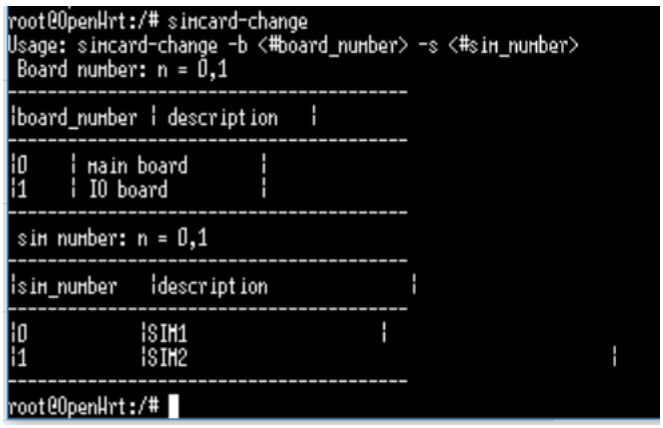
Check the mount command line:



# 5. CELLULAR, GPS, AND WIRELESS CONNECTIVITY

## 5.1 CELLULAR

For the cellular feature, user needs to install and activate the function first. Follow the step below to activate the cellular. **Note: Make sure the SIM Card has been installed before power on the device.**

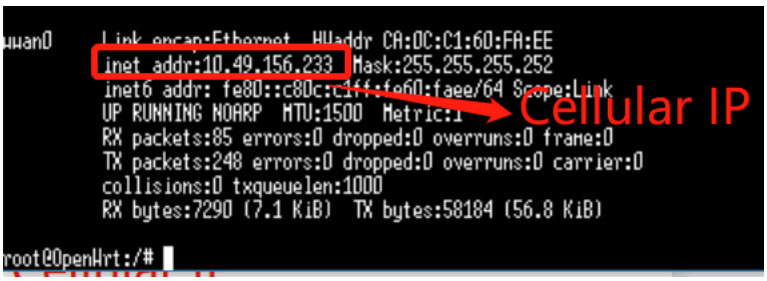
<table>
<tr>
<td rowspan="2">LTE module</td>
<td>SIM1</td>
<td>Default sim is SIM1.<br>(1.) ifconfig wwan0 up<br>(2.) uqmi -d /dev/cdc-wdm0 --start-network internet --autoconnect<br>(3.) Add DHCP client (add a wwan0 to the web page and select dhcp client), you can get the IP</td>
<td></td>
</tr>
<tr>
<td>SIM2</td>
<td>Change to SIM2<br>(1.)command to change SIM:simcard-change<br> 

<br>(2.) Execute command:simcard-change -b 1 -s 1<br> 

<br>(3.) microcom /dev/ttyUSB3 (Check the SIM Card)<br>Type: at+cfun=1,1<br>Type: at+ccid<br>Press CTRL+X<br>(4.) ifconfig wwan0 up<br>(5.) uqmi -d /dev/cdc-wdm0 --start-network internet --autoconnect<br>(6.) Add DHCP client (add a wwan0 to the web page and select dhcp client), you can get the IP</td>
<td></td>
</tr>
</table>

| | | | |
|---|---|---|---|
| | Connection | Establish the LTE connection<br>uqmi -d /dev/cdc-wdm0 --start-network internet –autoconnect<br><br>uqmi -d /dev/cdc-wdm0 --get-data-status<br>"connected"<br><br>uqmi -d /dev/cdc-wdm0 --get-data-status<br>"disconnected" | |
| | Check sim | Microcom /dev/ttyUSB3<br>Type: at+ccid<br>If the sim is detected then it will show the sim card id.<br>`root@Wr322:~# microcom /dev/ttyUSB3`<br>`at+ccid`<br>`+CCID: 89886891000288047481`<br><br>`OK`<br>If the sim card cannot be detected, it will show the CME Error.<br>`root@Wr322:~# microcom /dev/ttyUSB3`<br>`at+ccid`<br>`+CME ERROR: 13` | |
| | Change APN | (1.)Enter module configuration mode： Microcom /dev/ttyUSB3<br>(2.)Check APN:AT+CGDCONT?<br>(3.)Set APN:AT+CGDCONT=1,"IP","your_apn"<br>For example:Set APN to CNNET,<br>AT+CGDCONT=1,"IP","CNNET"<br>(4.)Exit module configuration mode::<br>Press CTRL+X | |

Using command “ifconfig” to query interface status:



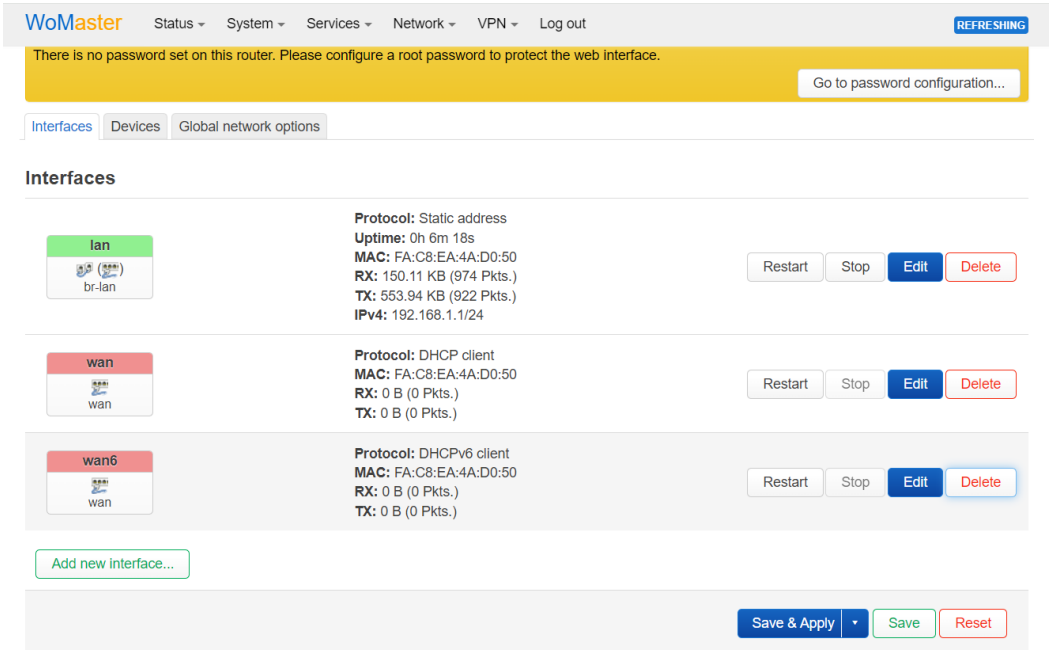

Using command “route” to query interface status:

```
root@OpenWrt:/# route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
default         10.49.156.234   0.0.0.0         UG    0      0        0 wwan0
10.49.156.232   *               255.255.255.252 U     0      0        0 wwan0
192.168.1.0     *               255.255.255.0   U     0      0        0 br-lan
root@OpenWrt:/#
root@OpenWrt:/#
```

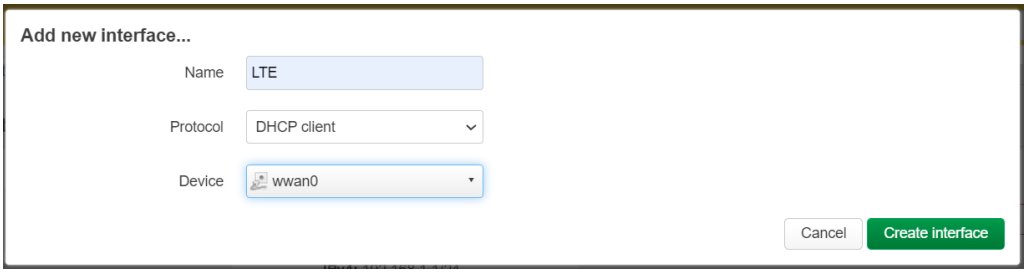
## Establish cellular connection through web UI

### Add the DCHP Client or the Cellular Interface

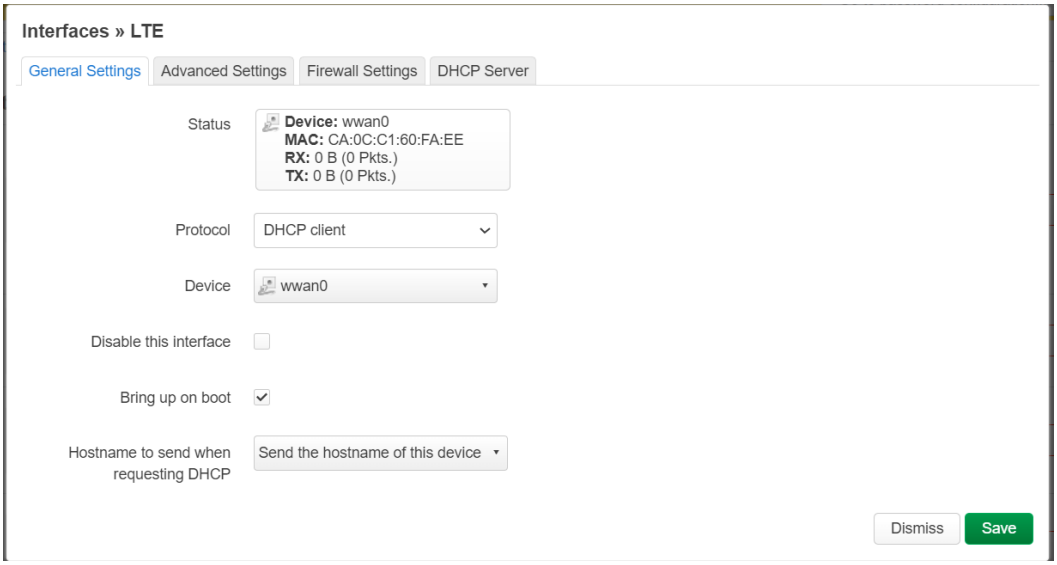
Go to Network -> Interface



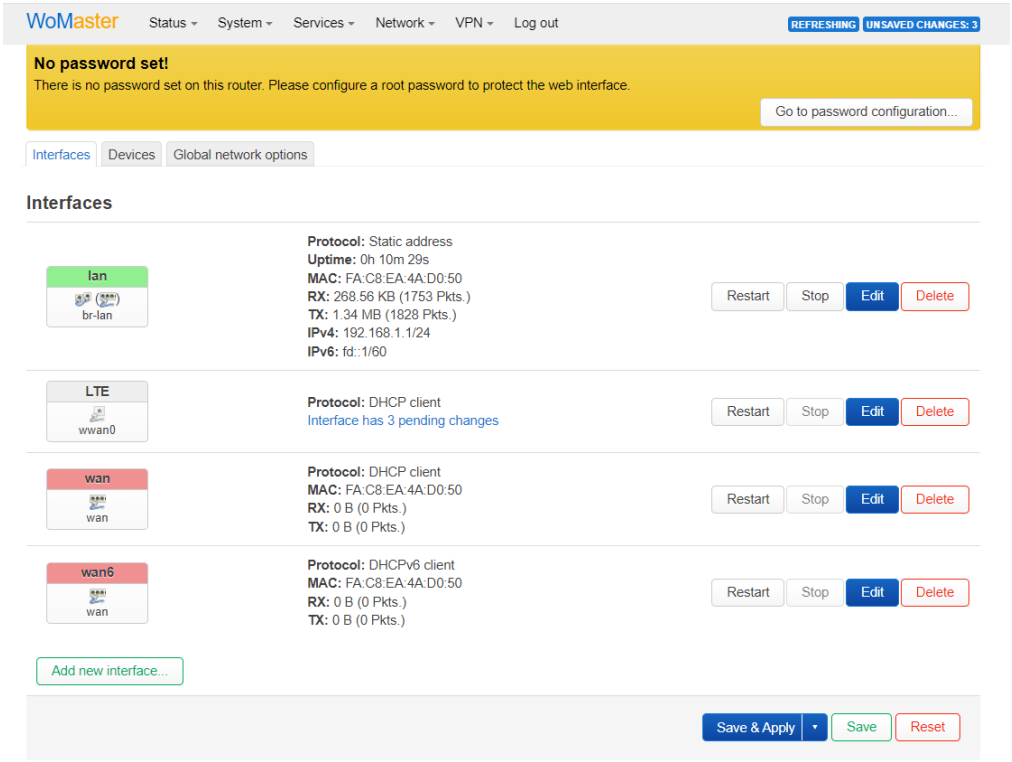

Click on “Add new interface”.Set parameters in the pop-up window.




Click on “Creat interface”,The following window will pop up.

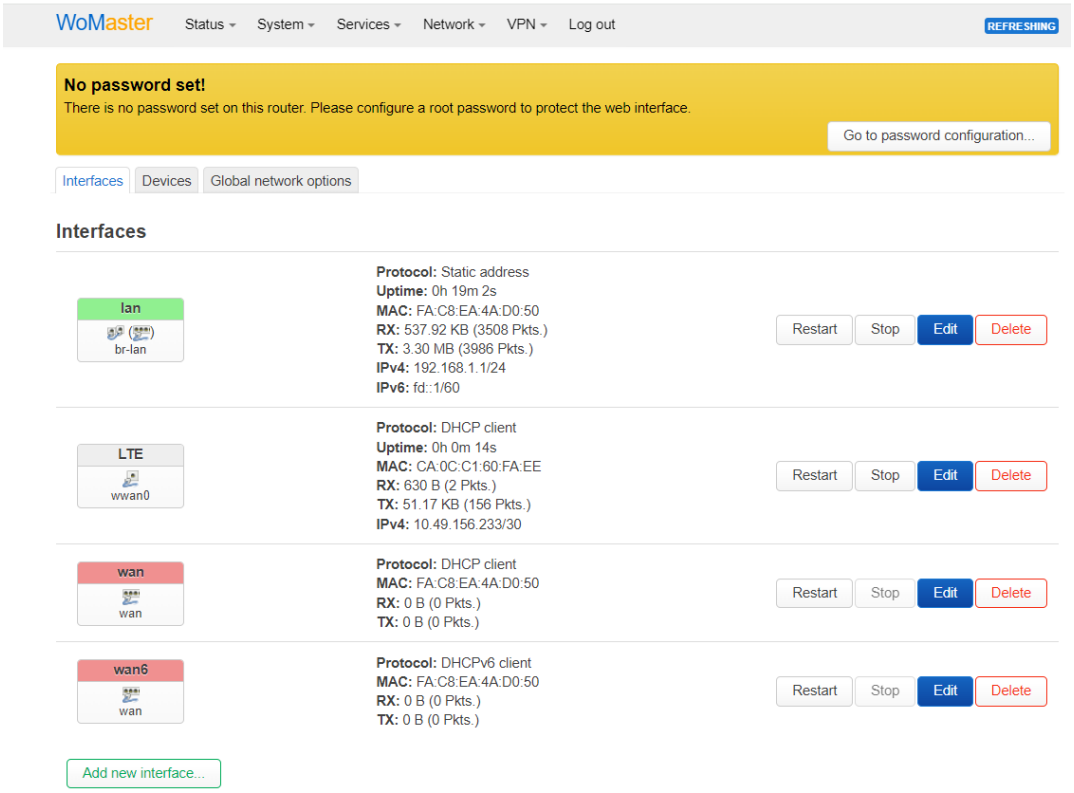



Then,click on “Save”,it will back to following page.



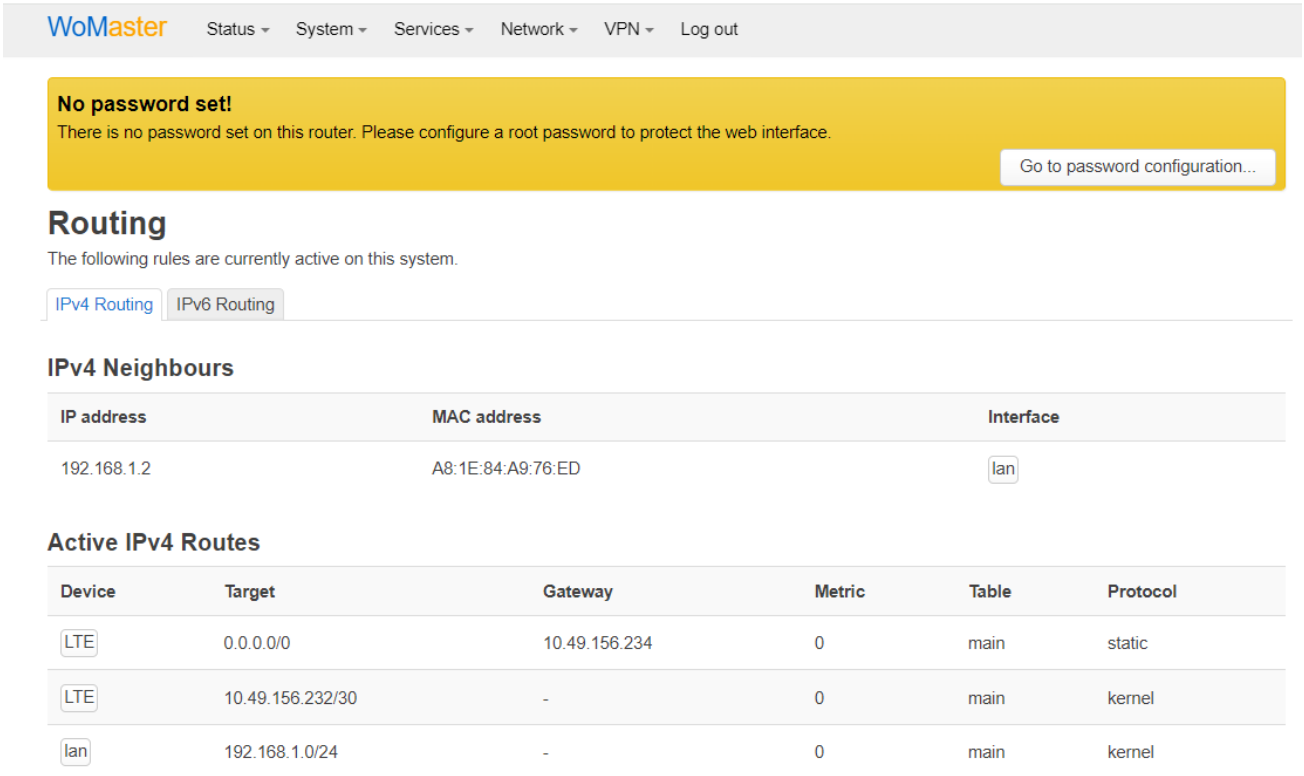

Click on “Save & Apply” to make the settings effective.

Wait a moment, LTE will be connected as following.




Check route table：

Go to Status ->Routing



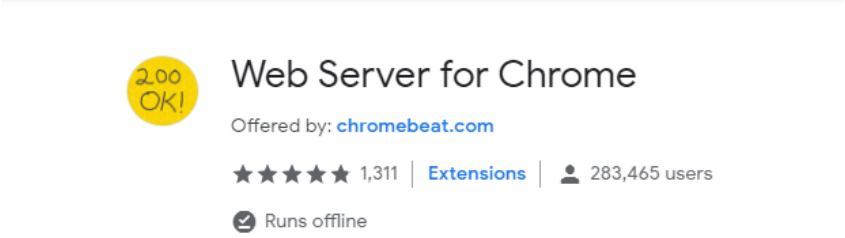
## 5.2 GPS (not support)

**Install the GPS feature to the device.**

1. **In your Chrome browser, open the link below**

   https://chrome.google.com/webstore/detail/web-server-for-chrome/ofhbbkphhbklhfoeikjpcbhemlocgigb

2. **Install and lunch the app (Web Server from Chrome)**




3. **Choose the web server's root dir. Copy the sdcard.tgz to the folder.**


4. **Login to device with ssh**
5. **Config the ip address with 'ifconfig br-lan <device's ip address>**
6. **Download gps.gcom to device with 'wget http://<user-pc-ip>:8887/gps.gcom .'**
7. **Type linux command 'sync' to make sure data has been write to the SD card.**
8. **Reboot and check**

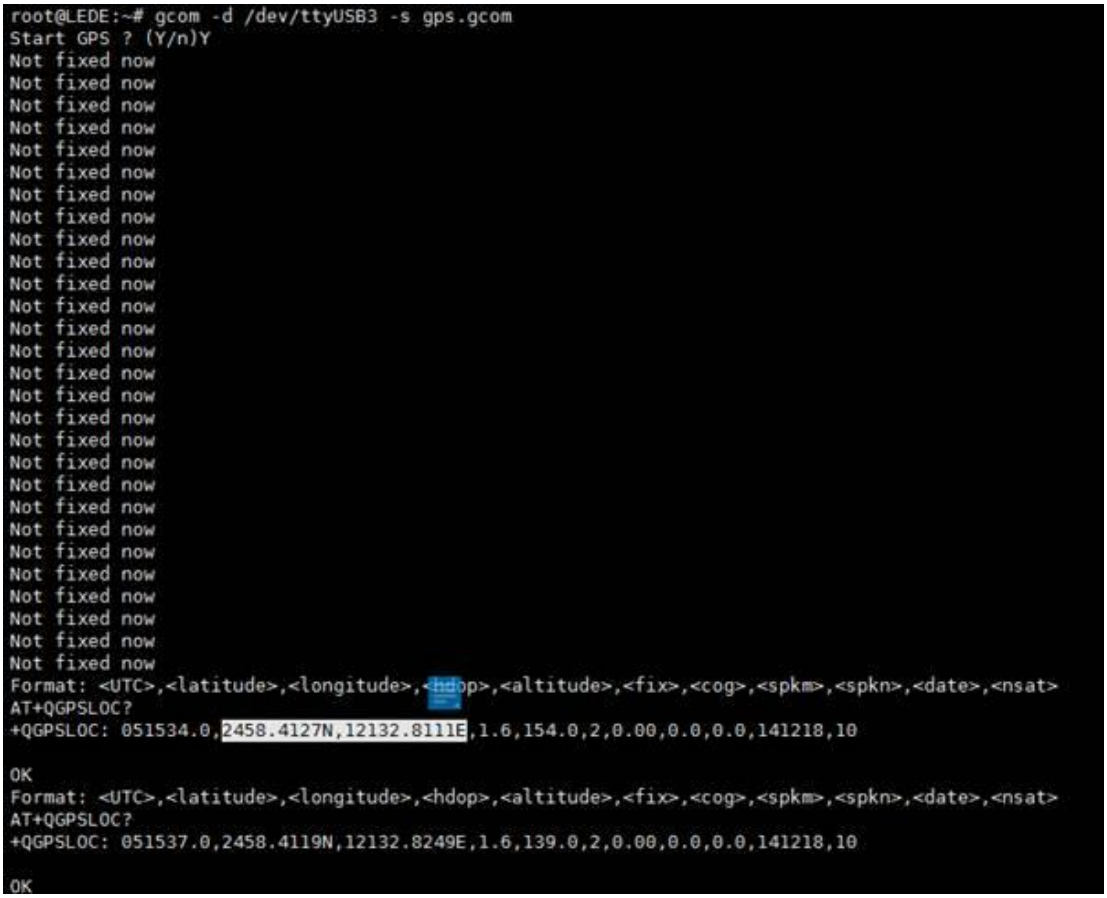
Below is the script to get the GPS information, user needs to save the script on a file (gps.gcom).

```
opengt
        set com 115200n81
```

```
        set senddelay 0.02
        set comecho off
        waitquiet 0.2 0.2
        flash 0.1

        print "Start GPS ? (Y/n)"
        input $a

        let $x=$left($a,1)
        #print $x
        if $x <> "Y" goto stopgps

:start
        send "AT+QGPS=1^m"
        get 1 "" $s
        #print $s

:getl
        send "AT+QGPSLOC=2^m"
        get 3 "" $s
        let $r=$mid($s,14,15)
        #print "|"$r"|"
        if $r = "+CME ERROR: 516" print "Not fixed now\n" goto getl
        print "Format: <UTC>,<latitude>,<longitude>,<hdop>,<altitude>,<fix>,<cog>,<spkm>,<spkn>,<date>,<nsat>\n"
        print $s
        goto getl

:stopgps
        print "Stop GPS \n"
        send "AT+QGPSEND^m"
        get 1 "" $s
        #print $s
```

Upload the “gps.gcom” script to the device, and run the command bellow:

**root@LEDE:~#** gcom -d /dev/ttyUSB3 -s gps.gcom




When the GPS is fixed, it will display in the following format

Format: <UTC>,<latitude>,<longitude>,<hdop>,<altitude>,<fix>,<cog>,<spkm>,<spkn>,<date>,<nsat>

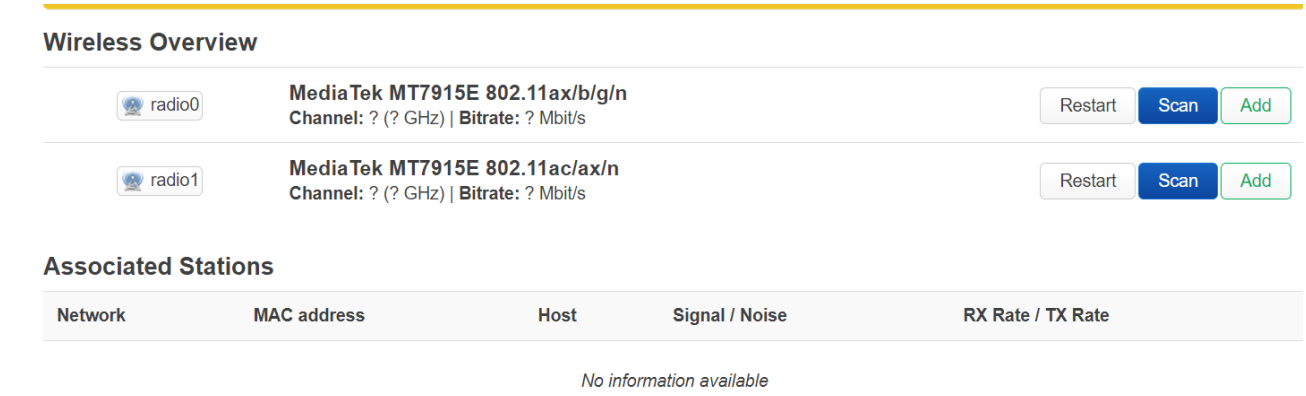
Press **ctrl + c** to stop the program.

## 5.3 WIRELESS

1. Go to Network -> Wireless

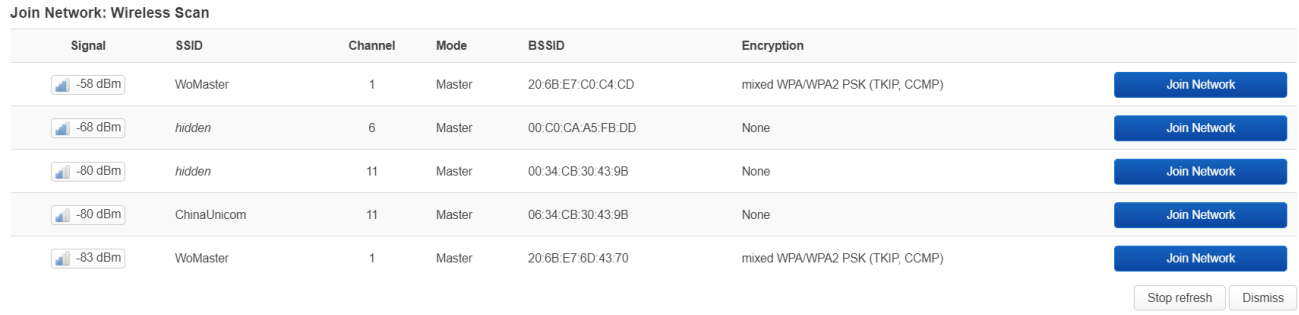
You can see the Wireless Overview as below.

Radio0 is for 2.4GHz,and radio1 is for 5GHz.




2. Click on “Resrart”,the device will be restarted.

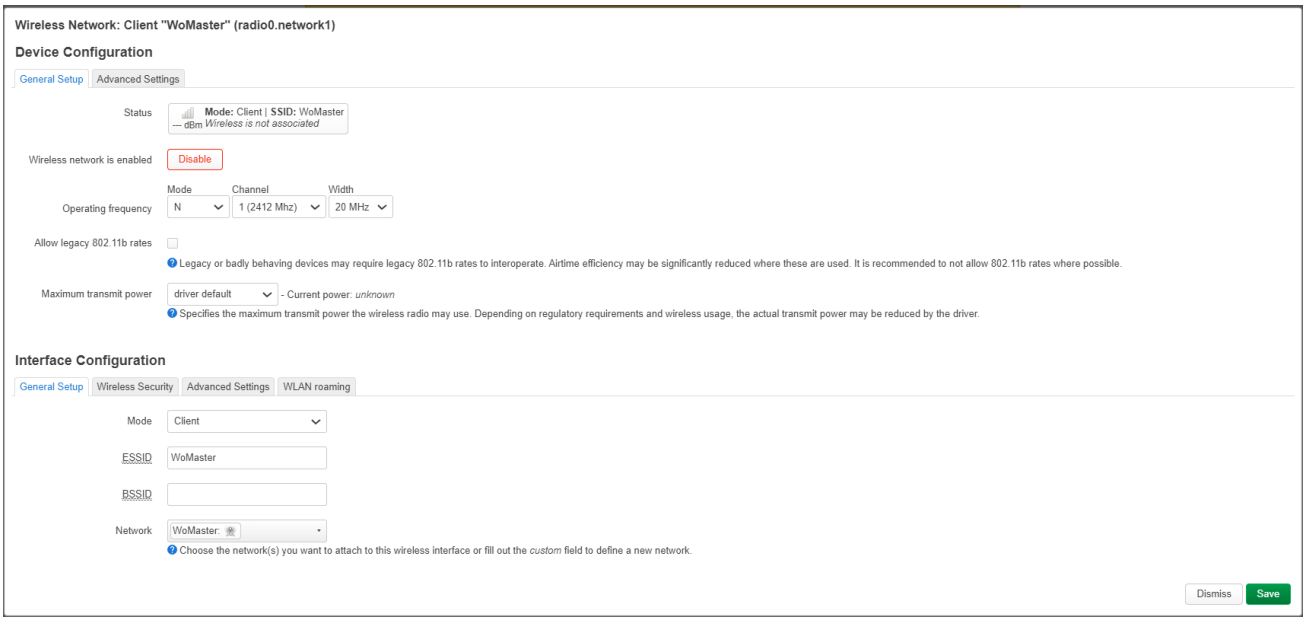

3. Click on “Scan”,it will scan the nearby wifi network.



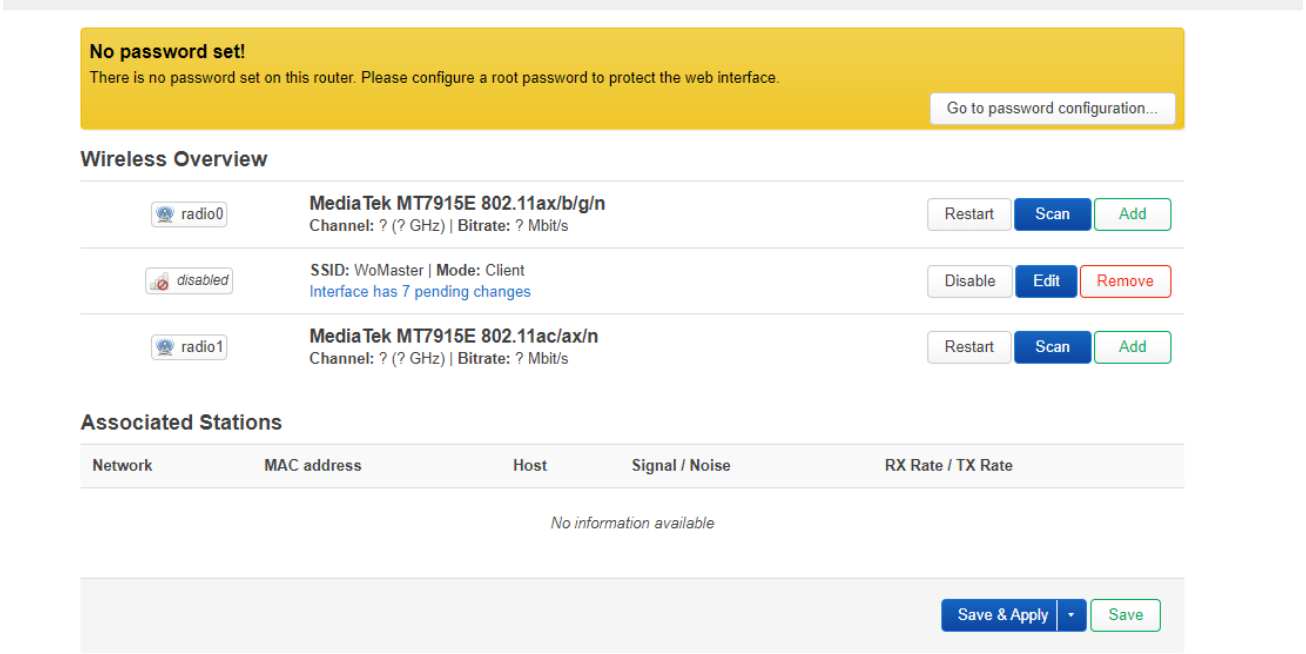

You can select one to join.

For example， select SSID： WoMaster to join.Click on “Join Network”.Set parameters according to the actual situation.

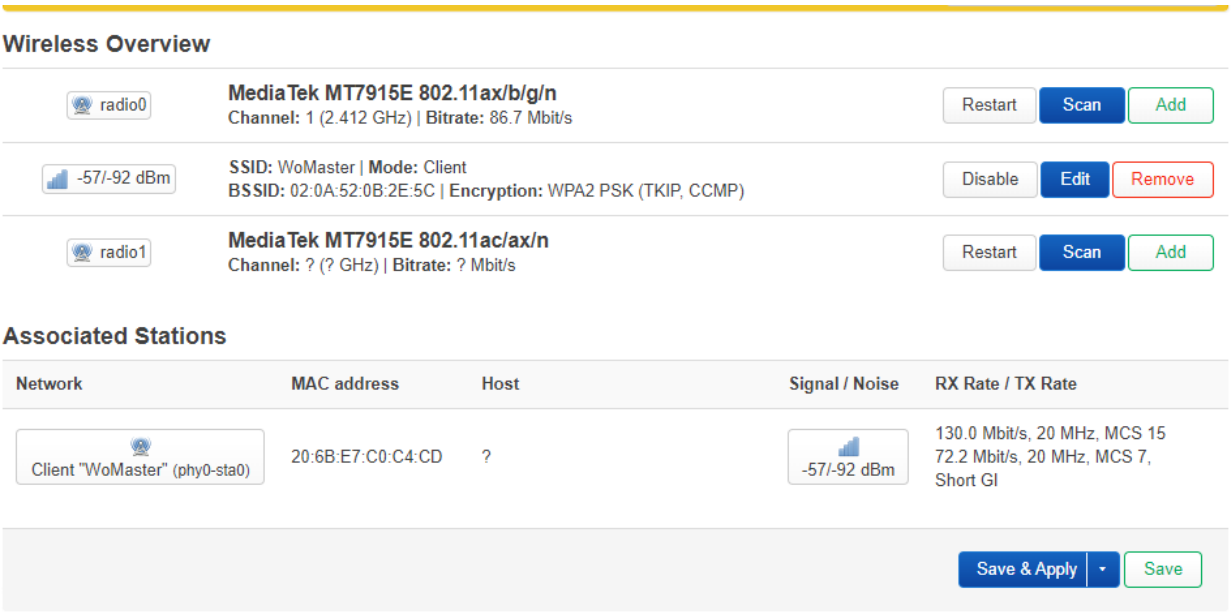

After clicking “Submit”,the following picture will appear：



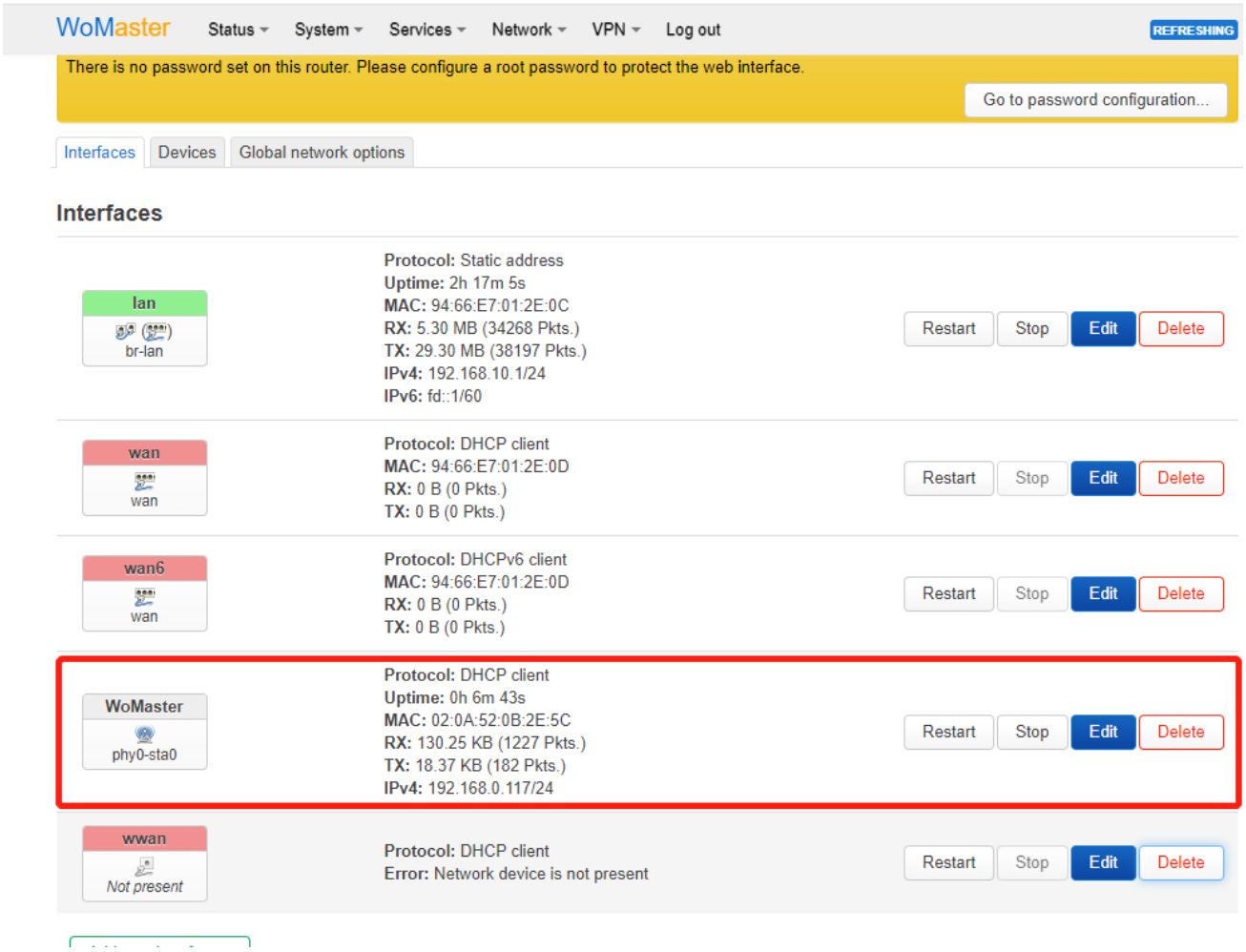

Then click on “Save”.It will back to Wireless Overview。



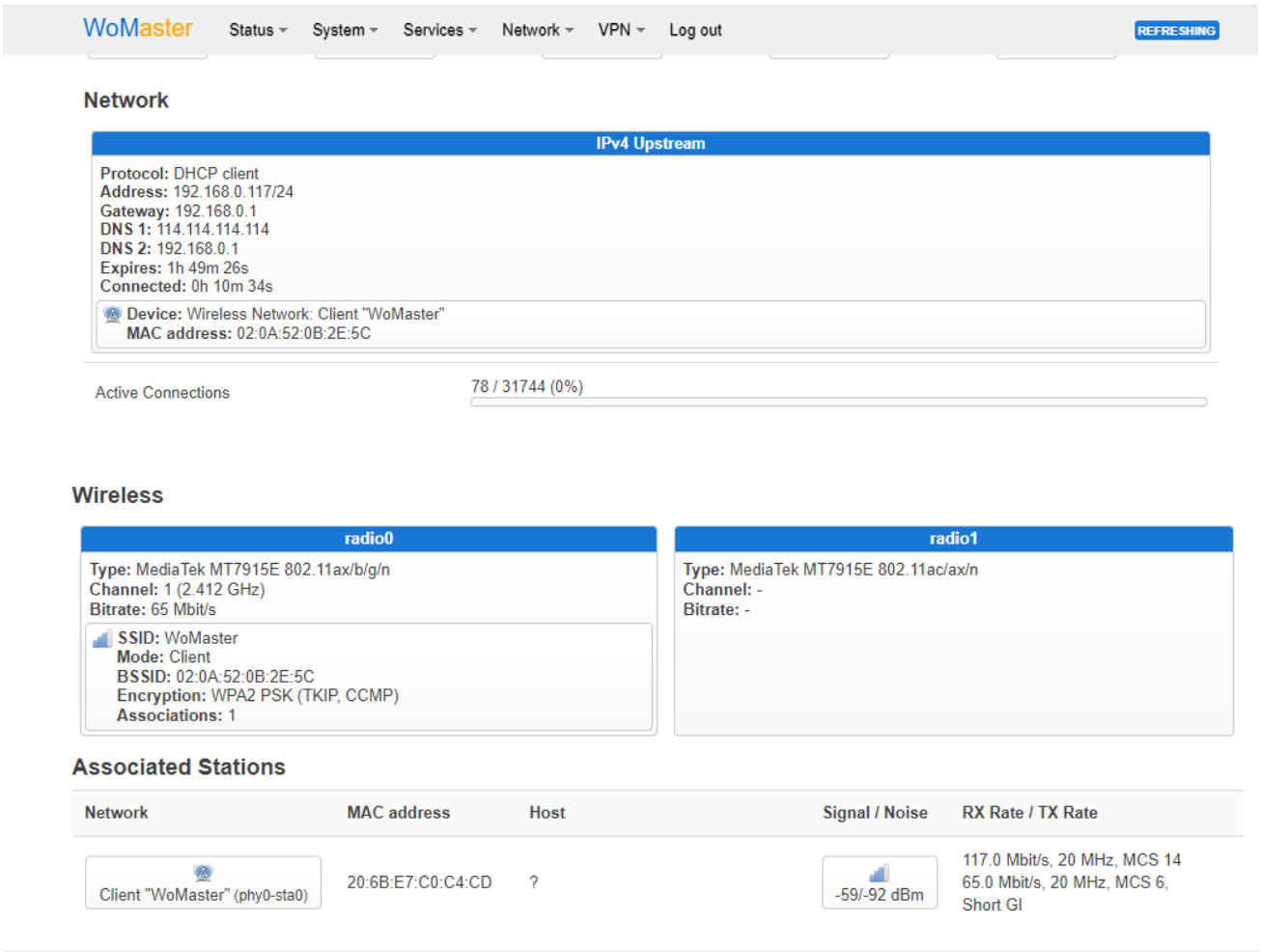

Then Click on “Save & Apply”,radio0 will join to the wifi network as a client.



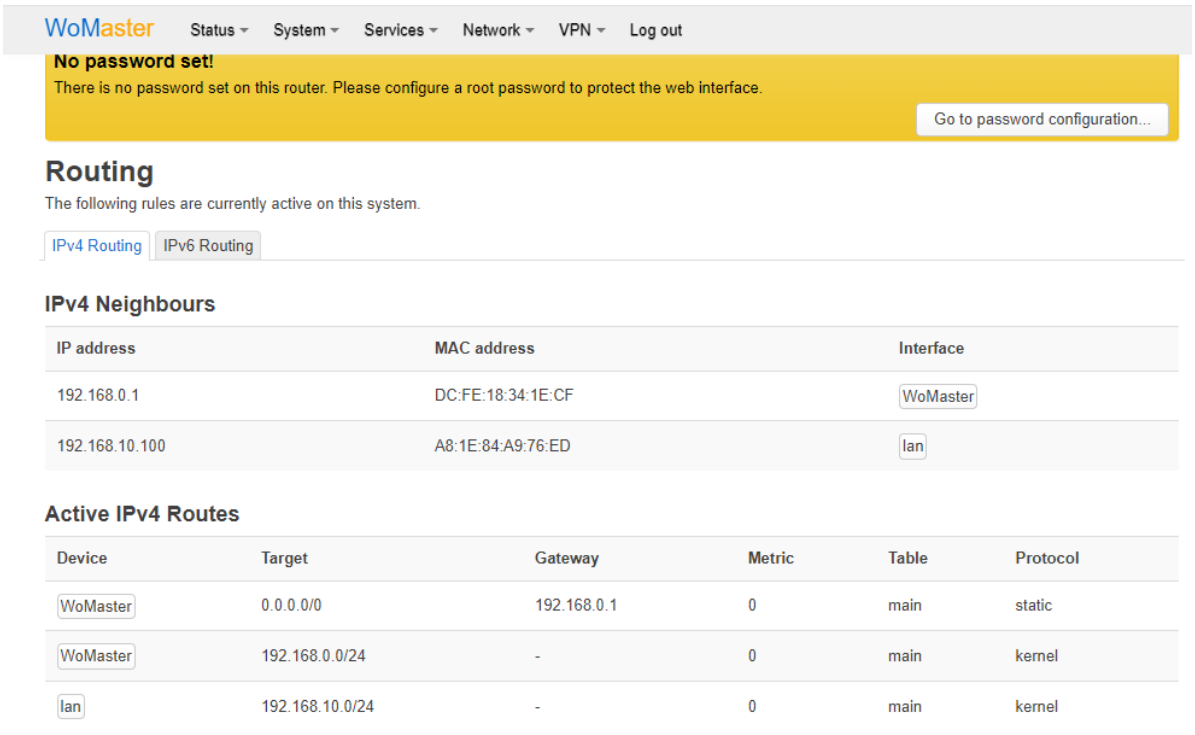

You can check the status and edit the interface parameters on Network -> Interface.




You also can check the status on Status -> Overview.

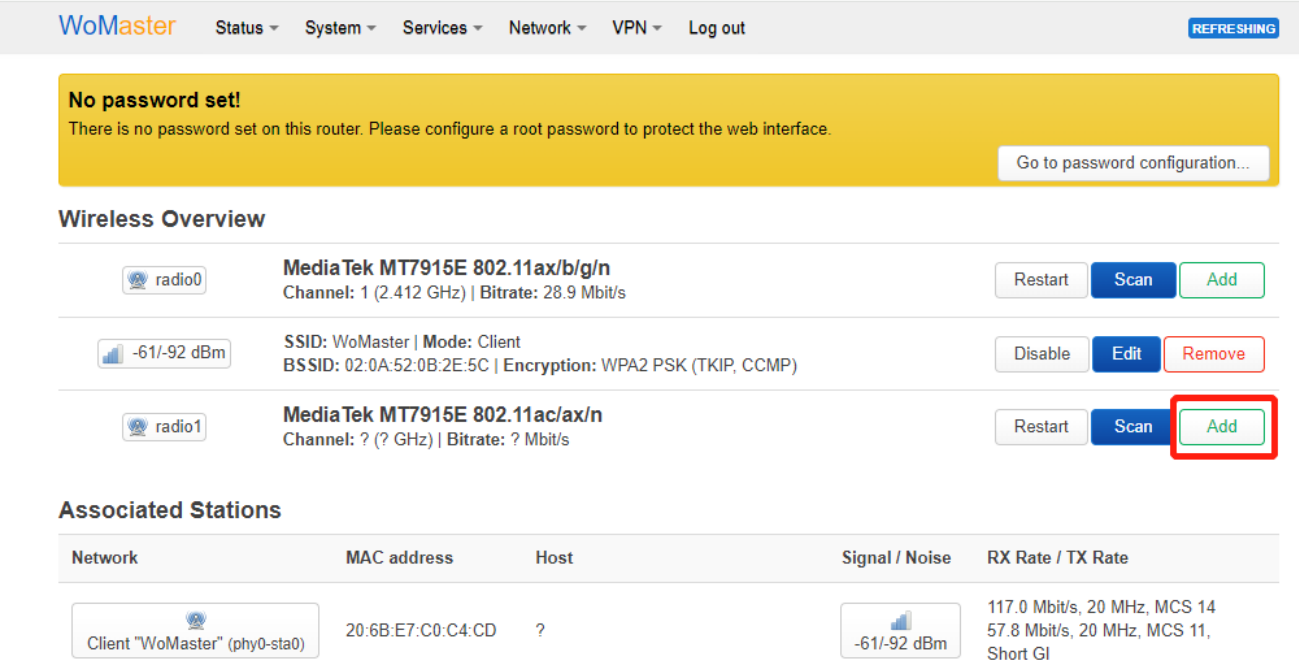



Check the routing Status -> Routing.

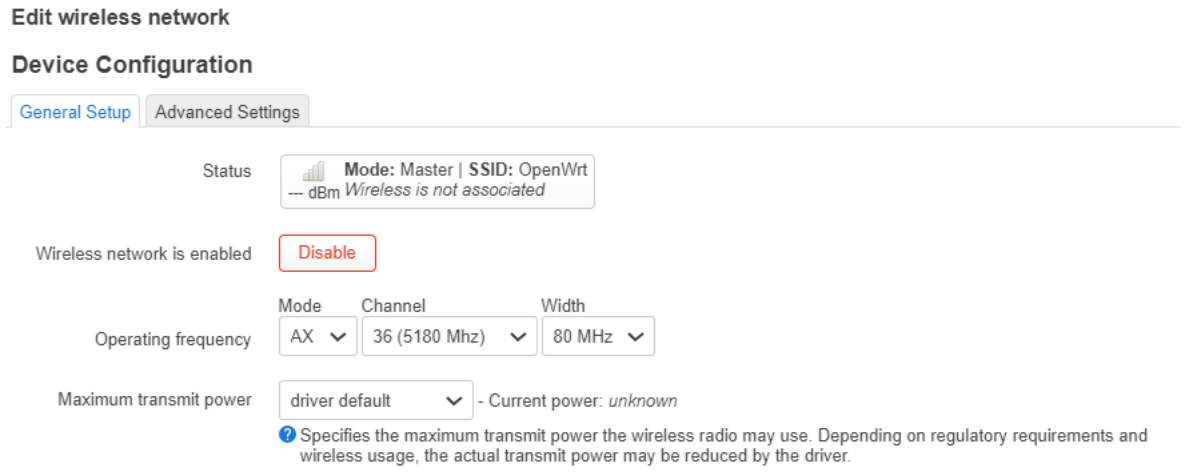


4.Below is how to set AP mode with Radio1.

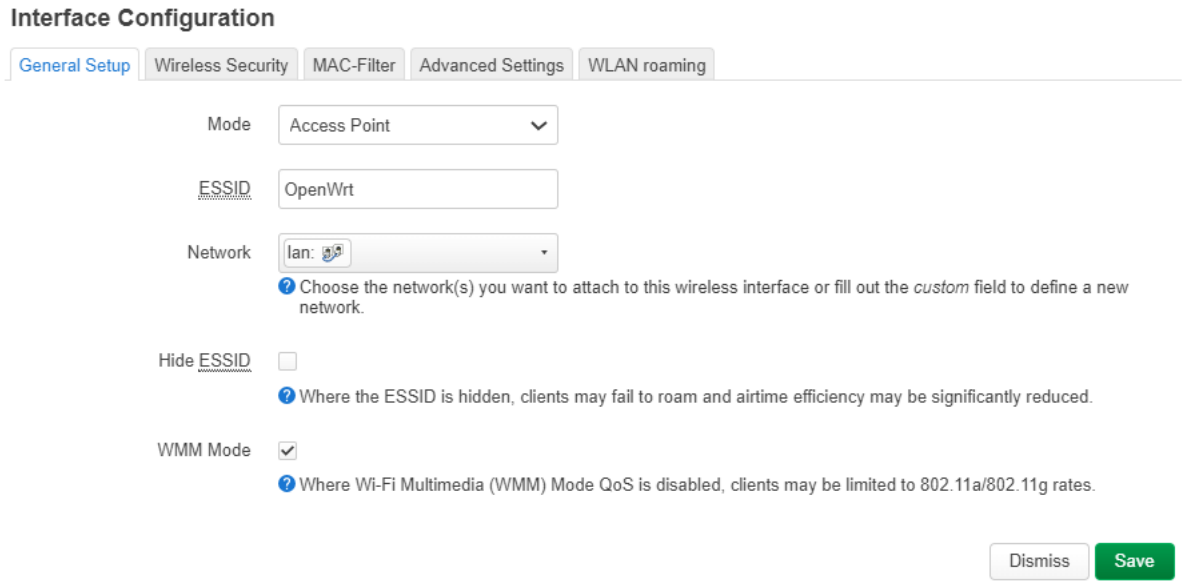
Click on “Add” on the Wireless Overview page。

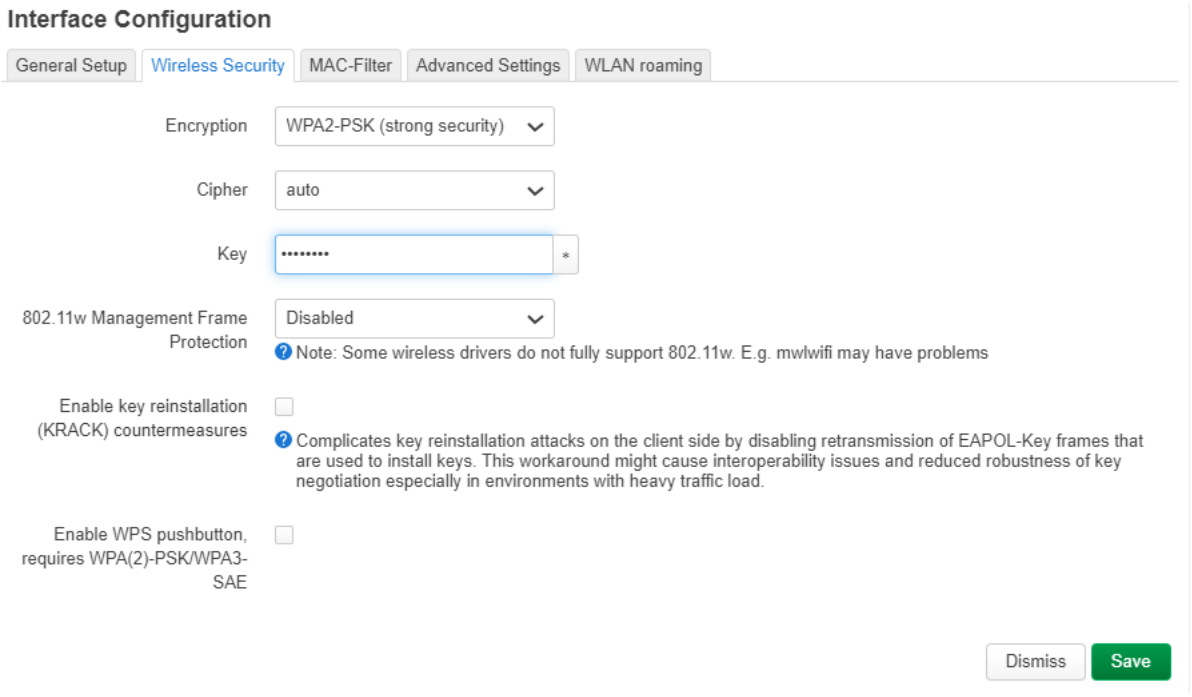



Below is for “Device Configuration”,for example Operation frquency.

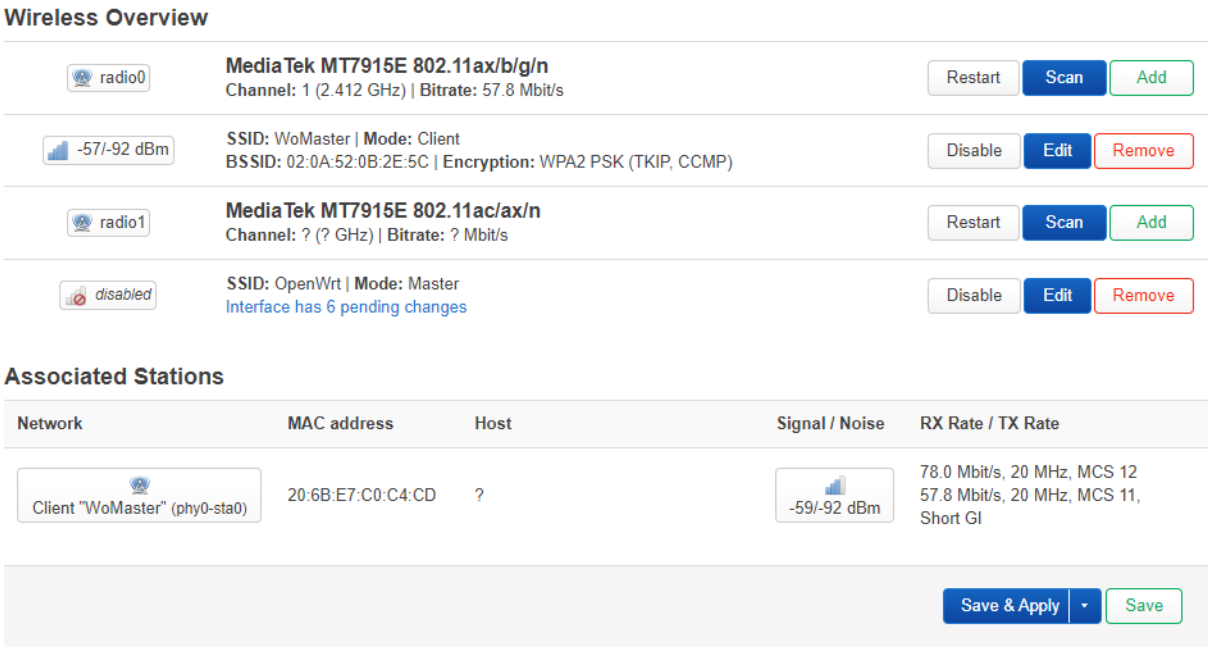



Below is Interface configuration。 Usually only two pages need to be configured as below。

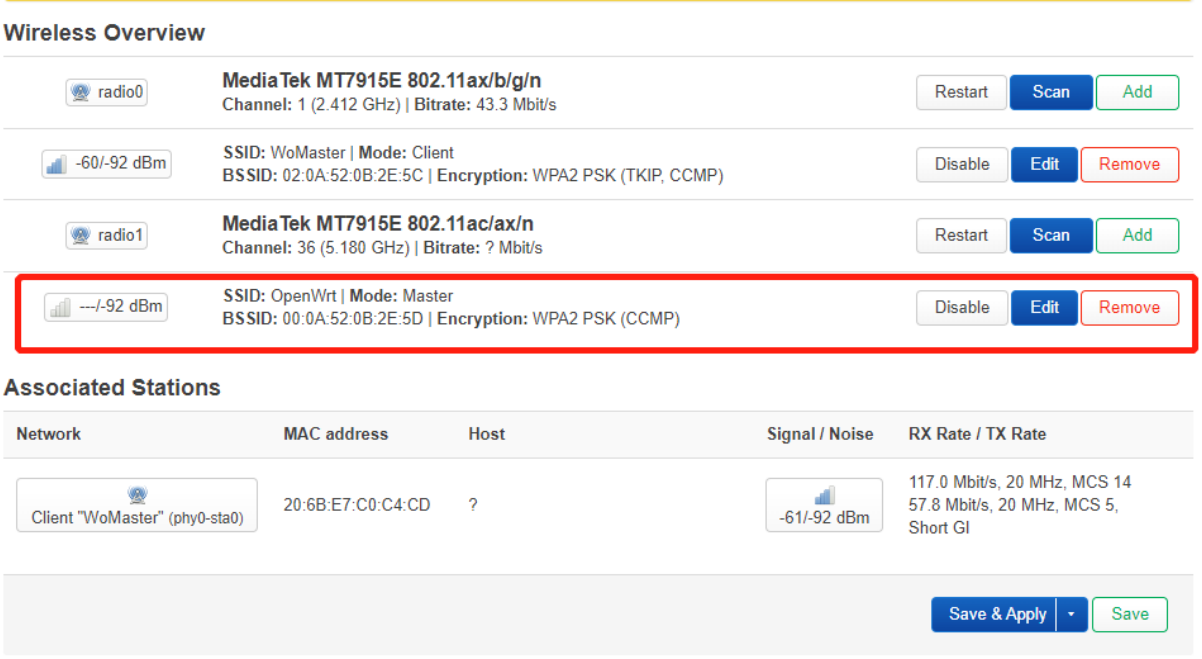


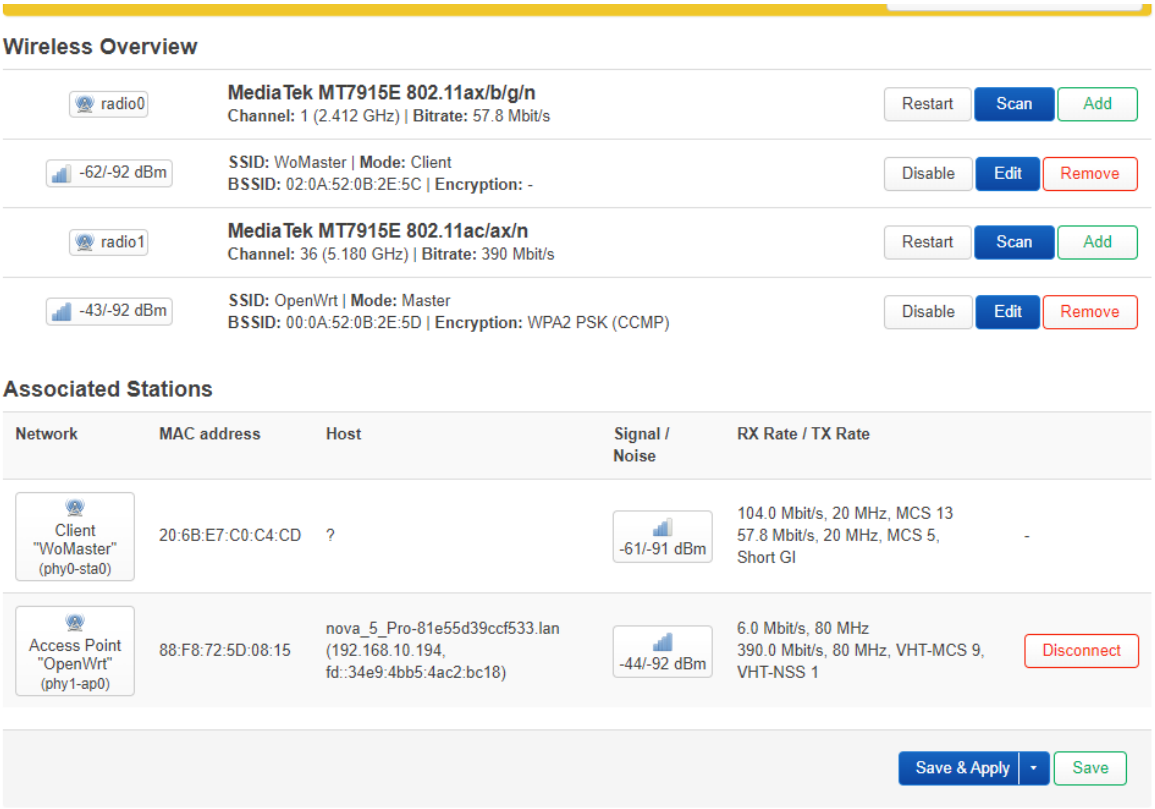

Click on “Save”,the following page will appear.




Click on “Save & Apply” to finish the setting.

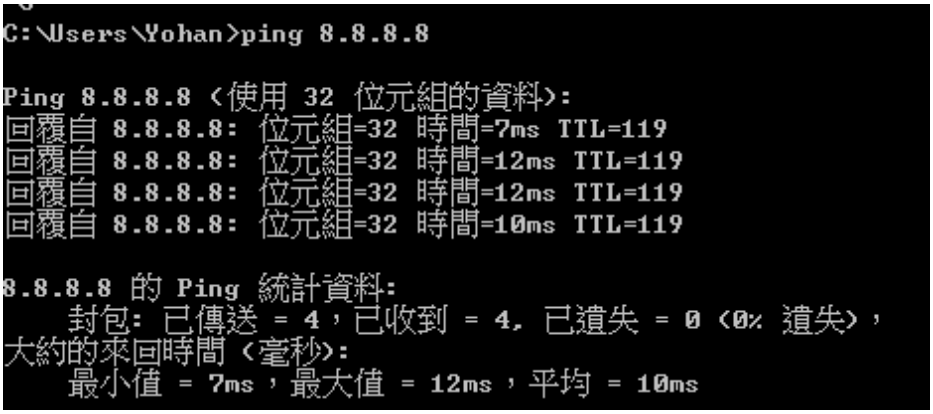


When wifi Client connet to wifi network of this SSID, it will be displayed in the “Associated Sataions” section.




4. Check the DHCP status on Network -> DHCP and DNS -> Active DHCP Lease to make sure if your client get the IP.


5. Try to ping to the internet from client. Ping 8.8.8.8



# 6. NETWORK FEATURES

In this chapter, we explain how to configure the Edge Computer various communication functions.

## 6.1 OpenVPN

OpenVPN is a full-featured SSL VPN which implements OSI layer 2 or 3 secure network extension using the industry standard SSL/TLS protocol, supports flexible client authentication methods based on certificates, smart cards, and/or username/password credentials, and allows user or group-specific access control policies using firewall rules applied to the VPN virtual interface.

This section covers several steps as below:

On each OpenVPN machine, you should generate a working directory, such as **/etc/openvpn**, where script files and key files reside. Once established, all operations will be performed in that directory.

### 6.1.1 Static-Key VPN

Run the following command in the /etc/openvpn directory to generate a static key:

```
root@LEDE:~# openvpn --genkey --secret static.key
```

Copy this static key to the clients /etc/openvpn directory using a secure channel like scp or sftp.

On the server, create a new /etc/openvpn/tun0.conf file and add the following:

```
dev tun0
ifconfig 10.9.8.1 10.9.8.2
secret /etc/openvpn/static.key
```

This is where 10.9.8.x is your VPN subnetwork; 10.9.8.1 is the IP of the server, and 10.9.8.2 the IP of the client.

On the client, copy /etc/openvpn/static.key from the server and create a new /etc/openvpn/tun0.conf file, and then add the following to the file:

```
remote myremote.mydomain
dev tun0
ifconfig 10.9.8.2 10.9.8.1
secret /etc/openvpn/static.key
```

Start OpenVPN using the following command:

```
root@LEDE:~# openvpn --config /etc/openvpn/tun0.conf --verb 6
```

**NOTE:**

**When using an OpenVPN-related application, you need to create a firewall policy.**

**Original example:** https://openvpn.net/community-resources/static-key-mini-howto/

**openvpn Link Reference:** https://openvpn.net/

## 6.2 ser2net: SERIAL TO NETWORK PROXY

ser2net provides a way for a user to connect from a network connection to a serial port. It could be like a bridge between the Ethernet cable and the serial cable.

The program comes up normally as a daemon, opens the TCP ports specified in the configuration file, and waits for connections. Once a connection occurs, the program attempts to set up the connection and open the serial port. If another user is already using the connection or serial port, the connection is refused with an error message.

| **Default config file** | /etc/ser2net.conf |
|---|---|

**OPTIONS**:

-c <config file> - use a config file besides /etc/ser2net.conf

-C <config line> - Handle a single configuration line. This may be specified multiple times for multiple lines. This is just like a line in the config file. This disables the default config file, you must specify a -c after the last -C to have it read a config file, too.

-p <controller port> - Start a controller session on the given TCP port

-P <file> - set location of pid file

-n - Don't detach from the controlling terminal

-d - Don't detach and send debug I/O to standard output

-l - Increate the debugging level

-u - Disable UUCP locking

-t <num threads> - Use the given number of threads, default 1

-b - unused (was Do CISCO IOS baud-rate negotiation, instead of RFC2217)

-v - print the program's version and exit

-s - specify a default signature for RFC2217 protocol

### 6.2.1 EXAMPLE

Setup a TCP server with following operation parameter:

Serial port : 1

TCP port : 3020

Baud rate : 9600

Data bits : 8

Parity : none

Stop bit : 1

Hardware flow control : none

State : raw state

timeout : never timeout

modem mode : none

Edit /etc/ser2net.conf add the following line:

```
3020:raw:0:/dev/ttyUSB1:9600 NONE 1STOPBIT 8DATABITS LOCAL -RTSCTS
```

Then run the ser2net program

```
root@LEDE:~# ser2net
```

## 6.3 IPSec

strongSwan is an OpenSource IPsec implementation, The focus of strongSwan is on

- simplicity of configuration
- strong encryption and authentication methods
- powerful IPsec policies supporting large and complex VPN networks
- modular design with great expandability

### 6.3.1 CONFIGURATION CONCEPT

If you have already worked with strongSwan you should know the different files you need to configure. It includes:

- /etc/strongswan.conf: Central configuration file
- /etc/ipsec.conf: Tunnel definitions
- /etc/ipsec.secrets: List of preshared keys
- /etc/ipsec.d: Folder for certificates

### 6.3.2 EXAMPLE SITE-TO-SITE

In this scenario two security gateways *moon* and *sun* will connect the two subnets moon-net and sun-net with each other through an IPSec VPN tunnel set up between the two gateways:

192.168.10.5/24 -- | 192.168.1.1 | === | 192.168.1.2 | -- 192.168.20.5/24

moon-net moon sun sun-net

**Configuration on gateway** sun**:**

/etc/ipsec.secrets:

```
# /etc/ipsec.secrets - strongSwan IPsec secrets file


%any : PSK "test"
```

/etc/ipsec.conf:

```
root@LEDE:/# cat /etc/ipsec.conf
# ipsec.conf - strongSwan IPsec configuration file

# basic configuration

config setup
        # strictcrlpolicy=yes
        # uniqueids = no

# Add connections here.

# Sample VPN connections

conn %default
        keylife=20m
        rekeymargin=3m
        keyingtries=1
        authby=secret
        keyexchange=ikev2
        mobike=no
        authby=secret
        ike=aes128-sha1-modp1024
        esp=aes128-sha1-modp1024

conn sample1
    leftsubnet=192.168.10.0/24
    left=192.168.1.1
    leftfirewall=yes
    right=192.168.1.2
    rightsubnet=192.168.20.0/24
    auto=start
```

**Configuration on gateway** moon:

/etc/ipsec.secrets:

```
root@LEDE:/# cat /etc/ipsec.secrets
```

```
# /etc/ipsec.secrets - strongSwan IPsec secrets file

%any : PSK "test"
```

/etc/ipsec.conf:

```
root@LEDE:/# cat /etc/ipsec.conf
# ipsec.conf - strongSwan IPsec configuration file

# basic configuration

config setup
        # strictcrlpolicy=yes
        # uniqueids = no

# Add connections here.

# Sample VPN connections

conn %default
        keylife=20m
        rekeymargin=3m
        keyingtries=1
        authby=secret
        keyexchange=ikev2
        mobike=no
        authby=secret
        ike=aes128-sha1-modp1024
        esp=aes128-sha1-modp1024

conn sample1
    leftsubnet=192.168.20.0/24
    left=192.168.1.2
    leftfirewall=yes
    right=192.168.1.1
    rightsubnet=192.168.10.0/24
    auto=start
```

Then execute

sun# ipsec start

Starting strongSwan 5.7.2 IPsec [starter]...

moon# ipsec start

Starting strongSwan 5.7.2 IPsec [starter]...

sun# ipsec status all

```
no files found matching '/etc/strongswan.d/*.conf'
Status of IKE charon daemon (strongSwan 5.5.3, Linux 4.4.92, mips):
   uptime: 33 minutes, since Oct 17 17:46:51 2017
   worker threads: 11 of 16 idle, 5/0/0/0 working, job queue: 0/0/0/0, scheduled: 0
   loaded plugins: charon aes des rc2 sha2 sha1 md5 random nonce x509 revocation constraints pubkey pkcs1 pgp
dnskey sshkey pem fips-prf gmp xcbc hmac attr kernel-netlink resolve socket-default connmark stroke updown
xauth-generic
Listening IP addresses:
   192.168.1.2
   192.168.20.1
Connections:
Security Associations (0 up, 0 connecting):
   none
```

moon# ipsec status all

```
no files found matching '/etc/strongswan.d/*.conf'
Status of IKE charon daemon (strongSwan 5.5.3, Linux 4.4.92, mips):
   uptime: 37 minutes, since Jan 09 12:43:05 2019
   worker threads: 11 of 16 idle, 5/0/0/0 working, job queue: 0/0/0/0, scheduled: 5
   loaded plugins: charon aes des rc2 sha2 sha1 md5 random nonce x509 revocation constraints pubkey pkcs1 pgp
dnskey sshkey pem fips-prf gmp xcbc hmac attr kernel-netlink resolve socket-default connmark stroke updown
xauth-generic
Listening IP addresses:
   192.168.1.1
   192.168.10.1
   fd99:4997:4c3::1
Connections:
       sample1:    192.168.1.1...192.168.1.1    IKEv2
       sample1:      local:    [192.168.1.1] uses pre-shared key authentication
```

```
        sample1:     remote: [192.168.1.1] uses pre-shared key authentication
        sample1:     child:    192.168.20.0/24 === 192.168.10.0/24 TUNNEL
Security Associations (2 up, 0 connecting):
        sample1[1]: ESTABLISHED 37 minutes ago, 192.168.1.1[192.168.1.1]...192.168.1.1[192.168.1.1]
        sample1[1]: IKEv2 SPIs: 43f1657886fc2de3_i* fec6474c2c978549_r, pre-shared key reauthentication in 2 hours
        sample1[1]: IKE proposal: AES_CBC_128/HMAC_SHA2_256_128/PRF_AES128_XCBC/MODP_3072
        sample1[2]: ESTABLISHED 37 minutes ago, 192.168.1.1[192.168.1.1]...192.168.1.1[192.168.1.1]
        sample1[2]: IKEv2 SPIs: 43f1657886fc2de3_i fec6474c2c978549_r*, pre-shared key reauthentication in 2 hours
        sample1[2]: IKE proposal: AES_CBC_128/HMAC_SHA2_256_128/PRF_AES128_XCBC/MODP_3072
```

**Original example:** https://www.strongswan.org/testing/testresults/ikev2/net2net-start/index.html

**StrongSwan Link Reference:** https://wiki.strongswan.org/projects/strongswan/wiki/UserDocumentation

# 7. ADVANCED FEATURE

## 7.1 wr-uart-ctl

| PROGRAM NAME | WR-UART-CTL |
|---|---|
| **Description** | **Serial Ports**<br>The serial ports support RS-232, RS-422, and RS-485 2-wire operation modes with flexible baudrate settings. The default operation mode is set to RS-232; use the **wr-uart-ctl** command to change the operation mode. |

**Usage**:

**Usage:** wr-uart-ctl -p <#port_number> -m <#uart_mode>

**Example:**

**Set serial port mode:**

**Port number:** n = 0,1

| port | Linux device name | Front panel name |
|---|---|---|
| 0 | /dev/ttyUSB0 | Serial1 |
| 1 | /dev/ttyUSB1 | Serial2 |

**uart mode:** As in the following table

| Uart mode | Operation Mode |
|---|---|
| None | Display current setting |
| 0 | RS-232 |
| 1 | RS-485 2-wire |
| 2 | RS-422 / RS-485 4-wire |

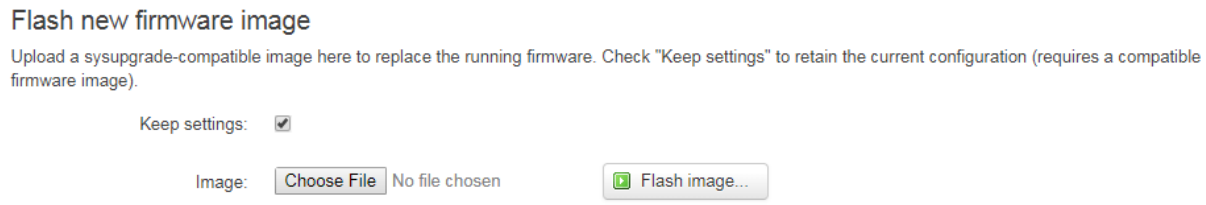
For example, to set Port 0 (com1) to RS-485 2-wire mode, use the following command:

root@LEDE:/# wr-uart-ctl -p 0 -m 1

## 7.2 FIRMWARE UPGRADE

From the web management, please follow the step below.

System -> Backup / Flash Firmware -> Flash New Firmware Image




**Note!** After upgrade the firmware, the SD card will need to be remounted manually again. Please follow the instructions below:

1. After the firmware upgrade.
2. Type 'df -h' check the SD card is not overlay on /
3. mount /dev/mmcblk0p1 /mnt
4. rm -f /mnt/etc/.extroot-uuid
6. umount /dev/mmcblk0p1
7. Run the extroot below command again

```
block detect > /etc/config/fstab; \
sed -i s/option$'\t'enabled$'\t'\'0\'/option$'\t'enabled$'\t'\'1\'/ /etc/config/fstab; \
sed -i s#/mnt/mmcblk0p1#/overlay# /etc/config/fstab; \
cat /etc/config/fstab;
```

8. Reboot and check the SD card is mounted and overlay on /

# 8. PROGRAMMING GUIDE

## 8.1 TEST PROGRAM DEVELOPING – HELLO.C

In this section, we use the standard “Hello world” programming example to illustrate how to develop a program for the edge computer.

### 8.1.1 SYSTEM REQUIREMENT FOR YOUR BUILD SERVER

The Linux Operating System must be pre-installed in the PC before installing the OpenWRT Toolchain. First we need to make sure the dependencies are installed (for Debian 9/Ubuntu 16.04) on your build server:

```
sudo apt-get install build-essential

sudo apt-get install subversion g++ zlib1g-dev build-essential git python rsync man-db

sudo apt-get install libncurses5-dev gawk gettext unzip file libssl-dev wget zip time
```

### 8.1.2 COMPILE C SOURCE CODE

**A. Download toolchain from the OpenWrt released supplementary files:**

$ wget https://archive.openwrt.org/releases/17.01.4/targets/ar71xx/generic/lede-sdk-17.01.4-ar71xx-generic_gcc-5.4.0_musl-1.1.16.Linux-x86_64.tar.xz

**B. Create toolchain dir**

$ sudo mkdir /opt/toolchains/

**C. Extract the toolchain to your working dir**

$ sudo tar Jxvf lede-sdk-17.01.4-ar71xx-generic_gcc-5.4.0_musl-1.1.16.Linux-x86_64.tar.xz -C /opt/toolchains/

**D. Add toolchain path to your $PATH environment**

$ export PATH=/opt/toolchains/lede-sdk-17.01.4-ar71xx-generic_gcc-5.4.0_musl-1.1.16.Linux-x86_64/staging_dir/toolchain-mips_24kc_gcc-5.4.0_musl-1.1.16/bin/:$PATH

**E. Write a Hello World program**

vim helloworld.c

```
#include <stdio.h>


int main(void)
{
	printf("\nHello, world!\n\n");
	return 0;
}
```

**F. Compile helloworld**

$ mips-openwrt-linux-gcc helloworld.c -o helloworld

**G. Upload helloworld to device**

Upload helloworld to the /tmp on device by scp program

**H. Execute helloworld on the device**

root@LEDE:/tmp# chmod +x helloworld

root@LEDE:/tmp# ./helloworld

**OpenWrt Link Reference:** https://openwrt.org/docs/guide-developer/helloworld/start

## 8.2 SYSTEM APIS

This section shows how to use some standard APIs on WoMaster's Edge computers.

### 8.2.1 WDT (WATCH DOG TIMER)

The WDT works like a watchdog function. You can enable it or disable it. When the WDT is enabled, but the application does not acknowledge it, the system will reboot. You can set the ack time from a minimum of 1 sec to a maximum of 1 day. The default timer is 60 seconds and the NO WAY OUT is enabled by default; there is no way to disable the watchdog once it has been started. For this reason, if the watchdog daemon crashes, the system will reboot after the timeout has passed.

**Show the watchdog setting**

root@LEDE:~# ubus call system watchdog

```
root@LEDE:~# ubus call system watchdog
{
        "status": "running",
        "timeout": 30,
        "frequency": 5,
        "magicclose": false
}
```

**To stop the watchdog function:**

root@LEDE:~# ubus call system watchdog '{ "stop": true }'

```
root@LEDE:~# ubus call system watchdog '{ "stop": true }'
{
        "status": "stopped",
        "timeout": 30,
        "frequency": 5,
        "magicclose": false
}
```

**To start the watchdog function:**

root@LEDE:~# ubus call system watchdog '{ "stop": false }'

```
root@LEDE:~# ubus call system watchdog '{ "stop": false }'
{
        "status": "running",
        "timeout": 30,
        "frequency": 5,
        "magicclose": false
}
```

**Watchdog link reference:** https://openwrt.org/docs/guide-developer/ubus/system

### 8.2.2 RTC (REAL TIME CLOCK)

Real Time Clock is a computer clock that keeps track of the current time. RTC can be used to complete time critical tasks. Using RTC can benefit from its lower power consumption and higher accuracy.

Below are the commands:

hwclock -r ... to "read" contents of RTC

```
root@LEDE:~# hwclock -r
2018-12-28 06:18:44.858654+0000
```

hwclock -s ... to "set" time/date from contents of RTC

hwclock -w ... to "write" current date into RTC

### 8.2.3 GPIO and LED control

GPIOs are represented by entries in the *sys* filesystem. You can check which GPIOs are available in the */sys/class/gpio* directory.

| **GPIO** | |
|---|---|
| **linux** | **description** |
| **/sys/class/gpio/gpio480** | **SIM_Select** |
| **/sys/class/gpio/gpio489** | **DO_GPIO** |
| **/sys/class/gpio/gpio491** | **DO_RELAY** |
| **/sys/class/gpio/gpio492** | **DI2_IN** |
| **/sys/class/gpio/gpio496** | **SW_Reset_Default** |
| **/sys/class/gpio/gpio497** | **Dying gasp** |
| **/sys/class/gpio/gpio498** | **DI1_IN** |
| **/sys/class/gpio/gpio403** | **EN_2nd_LTE_PWR** |
| **/sys/class/gpio/gpio414** | **PWRKEY_LGA** |
| **/sys/class/gpio/gpio415** | **RST_LGA** |
| **LED** | |
| **linux** | **description** |
| **/sys/class/gpio/gpio486** | **SYSTEM_LED** |
| **/sys/class/gpio/gpio487** | **SIM_detect_LED** |
| **/sys/class/gpio/gpio490** | **2G/3G LED** |
| **/sys/class/gpio/gpio493** | **4G LED** |
| **/sys/class/gpio/gpio494** | **Serial_1_LED** |
| **/sys/class/gpio/gpio495** | **Serial_2_LED** |
| **/sys/class/gpio/gpio400** | **2nd_4G_LED** |
| **/sys/class/gpio/gpio401** | **2nd_2G3G_LED** |
| **/sys/class/gpio/gpio402** | **2nd_SIM_detect_LED** |
| **RS232/422/485 Mode** | |
| **/sys/class/gpio/gpio408** | **SP339_TERM_01** |
| **/sys/class/gpio/gpio409** | **SP339_MODE1_01** |
| **/sys/class/gpio/gpio410** | **SP339_MODE0_01** |
| **/sys/class/gpio/gpio411** | **SP339_MODE0_02** |
| **/sys/class/gpio/gpio412** | **SP339_MODE1_02** |
| **/sys/class/gpio/gpio413** | **SP339_TERM_02** |

Example：

1、Lighten SYS LED

1）Set GPIO direction（Default：out）

echo out > /sys/class/gpio/gpio486/direction

2）Default value is 0，change to 1

echo 1 > /sys/class/gpio/gpio486/value

3）check SYS LED status

### 8.2.4 LED （not support）

All LEDs are represented by entries in the *sys* filesystem. You can check which LEDs are available in the */sys/class/leds* directory.

The name of an entry typically consists of the name of the hardware providing the LED (the router model), or it's designation (usually the label on the case).

| LED | COMMAND | SYS FILESYSTEM PATH |
|---|---|---|
| Power LED | Direct Link | NA |
| Serial1_LED | Web > System > LED Configuration | /sys/class/leds/s1 |
| Serial2_LED | Web > System > LED Configuration | /sys/class/leds/s2 |
| DO_RELAY / LED | Web > System > LED Configuration | /sys/class/leds/relay |
| SYSTEM_LED | Web > System > LED Configuration | /sys/class/leds/sys |
| Ra | Web > System > LED Configuration | /sys/class/leds/Ra |
| Rb | Web > System > LED Configuration | /sys/class/leds/Rb |
| Rc | Web > System > LED Configuration | /sys/class/leds/Rc |
| Rd | Web > System > LED Configuration | /sys/class/leds/Rd |
| Re | Web > System > LED Configuration | /sys/class/leds/Re |
| Rf | Web > System > LED Configuration | /sys/class/leds/Rf |
| Port 1 LED | Direct Link | NA |
| Port 2 LED | Direct Link | NA |

The LED can be controlled by various events in the system, which is selected by the *trigger* option. Depending on the trigger, additional options must be specified.

First of all, you need to know which triggers are available for a led, to do that simply look at the *trigger* file of that led. Example:

```
root@LEDE:/# cat /sys/class/leds/Ra/trigger
[none] timer default-on netdev gpio heartbeat oneshot phy0rx phy0tx phy0assoc phy0radio phy0tpt
```

If we wanted to (temporarily) assign a **default-on** trigger to the led, we would write

```
root@LEDE:/# echo "default-on" > /sys/class/leds/Ra/trigger
```

You can confirm that you changed this by using cat again, you will see it has changed and the selected trigger is highlighted.

```
root@LEDE:/# cat /sys/class/leds/Ra/trigger
none timer [default-on] netdev gpio heartbeat oneshot phy0rx phy0tx phy0assoc phy0radio phy0tpt
```

Now, this change will be lost on reboot, if you want to make a permanent change, you need to add the trigger in uci configuration. If this is the first time, you don't have any configuration for it, you can add it and the trigger by editing the following example text (that sets Ra led as “default-on” and then copy-pasting it whole in the terminal window.

```
rule_name=$(uci add system led_ra)
uci batch <<EOF
set system.$rule_name=led
set system.$rule_name.name='Ra'
set system.$rule_name.sysfs='Ra'
set system.$rule_name.trigger='default-on'
EOF

uci commit
```

Now, if you want change the trigger assigned to Ra into “heartbeat” and you already have a block of options for it like this when you write **uci show system | grep “system.Ra”** (you can have more or less, it may also not have a trigger already assigned).

```
root@LEDE:/# uci set system.@led[0].trigger='heartbeat'
root@LEDE:/# uci commit
```

Types of led trigger can be found in the following link.

Link References: https://openwrt.org/docs/guide-user/base-system/led_configuration

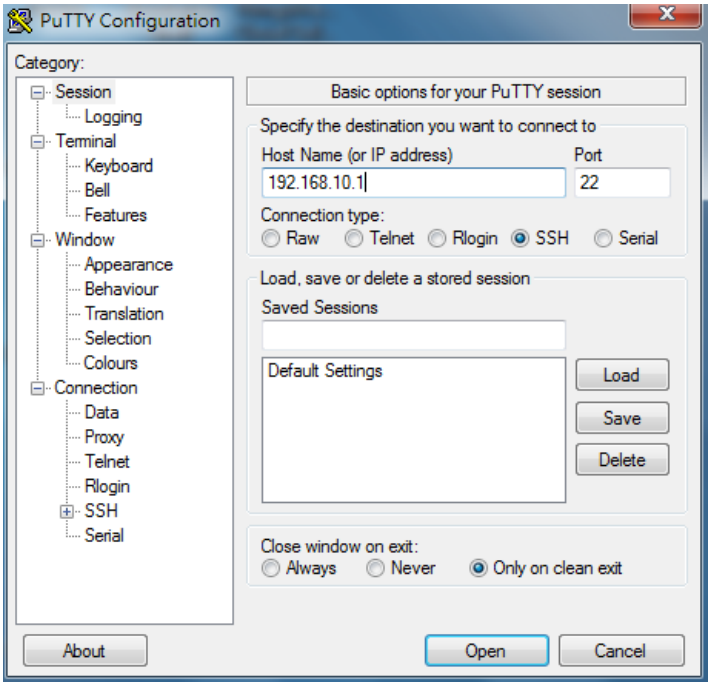
## 8.3 NODE-RED

WoMaster Edge Computer is equipped with Node-Red. Node-RED is a flow-based development tool for visual programming developed originally by IBM for wiring together hardware devices, APIs and online services as part of the Internet of Things. Node-RED provides a web browser-based flow editor, which can be used to create JavaScript functions.

### 8.3.1 OPEN THE NODE-RED

**To execute the Node-Red please follow the step below:**

The device supports an SSH Console. Open a putty or any software and set up an SSH console for the Edge Computer in a Windows environment.



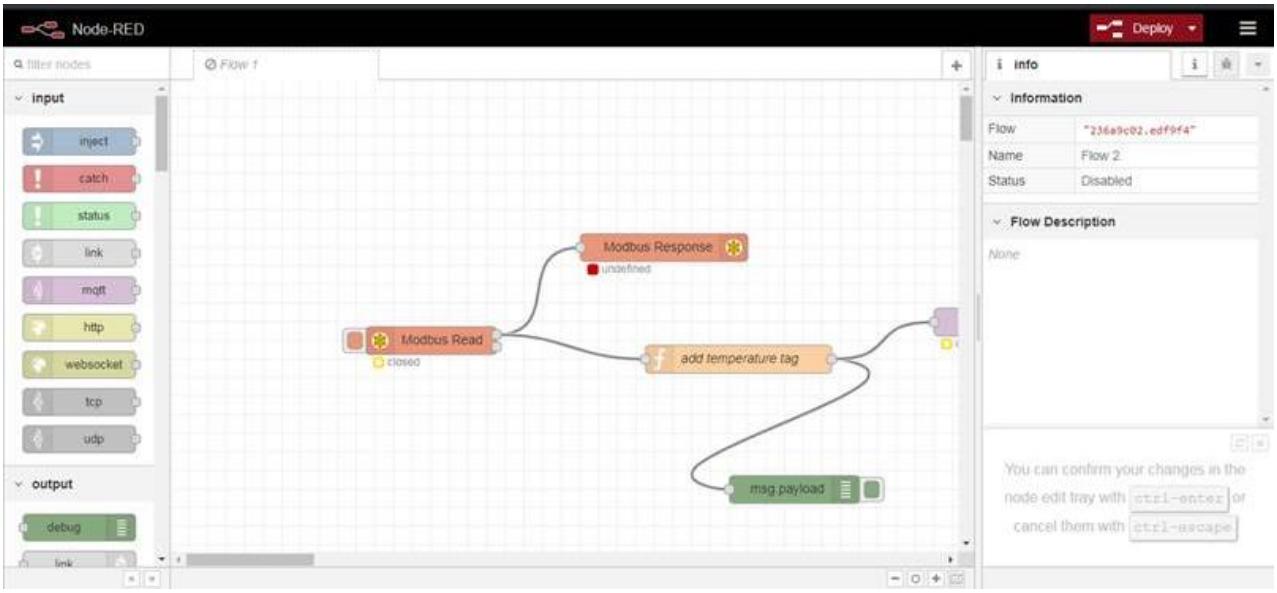
Then type **“node-red”** on the command line and press Enter. Wait till the establishing process is done.

```
root@LEDE:~# node-red
4 Jan 02:45:30 - [info]

Welcome to Node-RED
===================

4 Jan 02:45:30 - [info] Node-RED version: v0.19.4
4 Jan 02:45:30 - [info] Node.js  version: v8.12.0
4 Jan 02:45:30 - [info] Linux 4.4.92 mips BE
4 Jan 02:45:40 - [info] Loading palette nodes
4 Jan 02:45:45 - [warn] rpi-gpio : Raspberry Pi specific node set inactive
4 Jan 02:45:45 - [warn] rpi-gpio : Cannot find Pi RPi.GPIO python library
4 Jan 02:45:59 - [info] Settings file  : /root/.node-red/settings.js
4 Jan 02:45:59 - [info] Context store  : 'default' [module=memory]
4 Jan 02:45:59 - [info] User directory : /root/.node-red
4 Jan 02:45:59 - [warn] Projects disabled : editorTheme.projects.enabled=false
4 Jan 02:45:59 - [info] Flows file     : /root/.node-red/flows_LEDE.json
4 Jan 02:46:00 - [info] Server now running at http://127.0.0.1:1880/
4 Jan 02:46:00 - [warn]

---------------------------------------------------------------------
Your flow credentials file is encrypted using a system-generated key.

If the system-generated key is lost for any reason, your credentials
file will not be recoverable, you will have to delete it and re-enter
your credentials.

You should set your own key using the 'credentialSecret' option in
your settings file. Node-RED will then re-encrypt your credentials
file using your chosen key the next time you deploy a change.
---------------------------------------------------------------------

4 Jan 02:46:00 - [info] Starting flows
4 Jan 02:46:00 - [info] Started flows
```

Open the node-red on your browser: <EC Series IP Address>:1880

**For example:** 192.168.1.1:1880

And you will directly see the node-red interface.



## 8.3.2 CREATE SIMPLE FLOW

**1. Add an Inject node**

The Inject node allows you to inject messages into a flow, either by clicking the button on the node, or setting a time interval between injects.

Drag one onto the workspace from the palette.

Open the sidebar (Ctrl-Space, or via the dropdown menu) and select the Info tab.

Select the newly added Inject node to see information about its properties and a description of what it does.

**2. Add a Debug node**

The Debug node causes any message to be displayed in the Debug sidebar. By default, it just displays the payload of the message, but it is possible to display the entire message object.

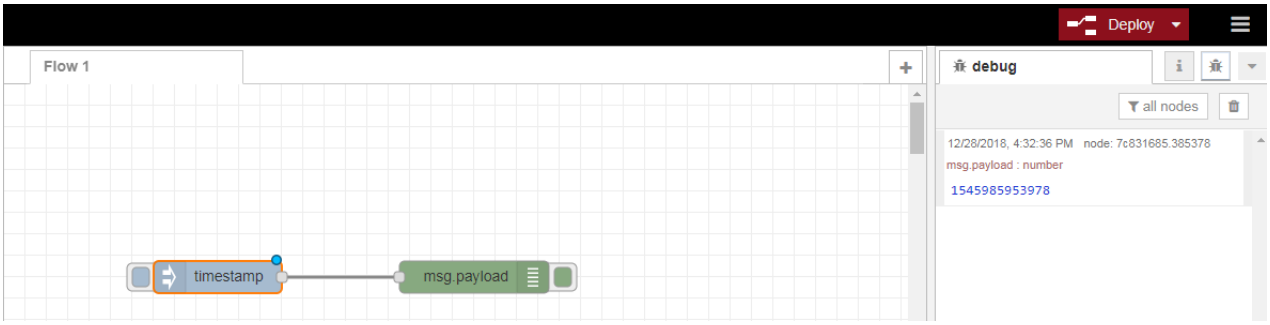
**3. Wire the two together**

Connect the Inject and Debug nodes together by dragging between the output ports of one to the input port of the other.

**4. Deploy**

At this point, the nodes only exist in the editor and must be deployed to the server.

Click the Deploy button. With the Debug sidebar tab selected, click the Inject button. You should see numbers appear in the sidebar. By default, the Inject node uses the number of milliseconds since January 1st, 1970 as its payload. Let's do something more useful with that.



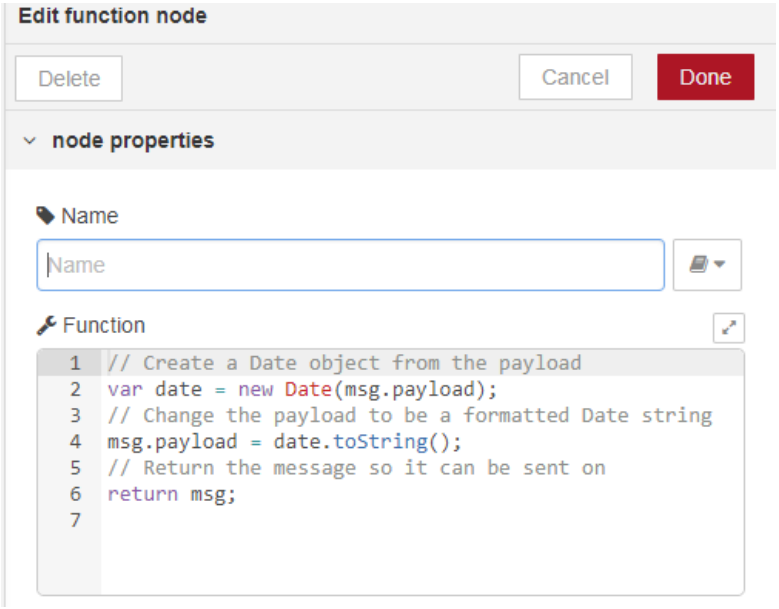

**5. Add a Function node**

The Function node allows you to pass each message though a JavaScript function.

Wire the Function node in between the Inject and Debug nodes. You may need to delete the existing wire (select it and hit delete on the keyboard).

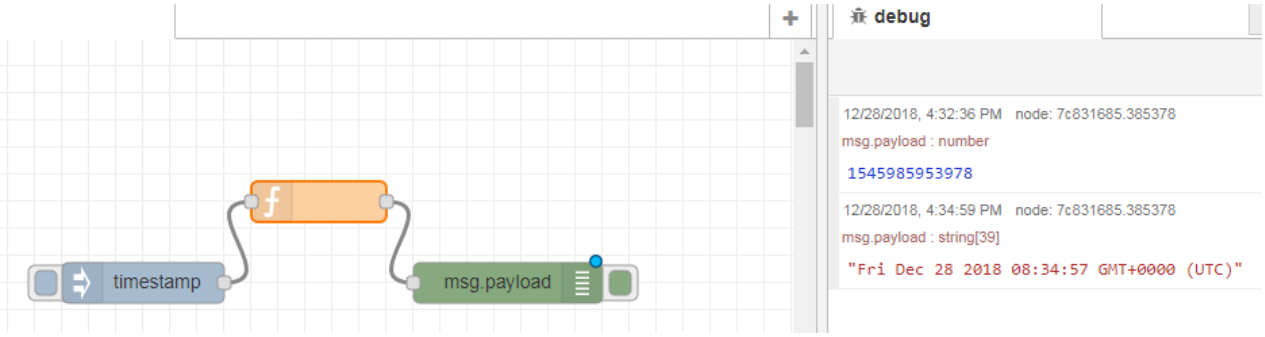
Double-click on the Function node to bring up the edit dialog. Copy the follow code into the function field:

```
// Create a Date object from the payload
var date = new Date(msg.payload);
// Change the payload to be a formatted Date string
msg.payload = date.toString();
// Return the message so it can be sent on
return msg;
```




Click Ok to close the edit dialog and then click the deploy button.

Now when you click the Inject button, the messages in the sidebar will be more readable time stamps.



### SOURCE

The flow created in this example is represented by the following json. It can be imported straight into the editor by pasting the json into the Import dialog (Ctrl-I or via the dropdown menu).


```
[{"id":"c5ba81c5.8fc89","type":"tab","label":"Flow 1","disabled":false,"info":""},{"id":"99bdf2d8.0c5aa","type":"inject","z":"c5ba81c5.8fc89","name":"","topic":"","payload":"","payloadType":"date","repeat":"","crontab":"","once":false,"onceDelay":0.1,"x":200,"y":180,"wires":[["edd0d57.cfabb28"]]},{"id":"7c831685.385378","type":"debug","z":"c5ba81c5.8fc89","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"false","x":470,"y":180,"wires":[]},{"id":"edd0d57.cfabb28","type":"function","z":"c5ba81c5.8fc89","name":"","func":"// Create a Date object from the payload\nvar date = new Date(msg.payload);\n// Change the payload to be a formatted Date string\nmsg.payload = date.toString();\n// Return the message so it can be sent on\nreturn msg;\n","outputs":1,"noerr":0,"x":330,"y":120,"wires":[["7c831685.385378"]]}]
```


## 8.3.3 NODE-RED CONFIGURATION FILE

Use --userDir parameter to specify which folder to load the node red flows.

For example: The node red flows are in /root/.node-red/, and then it can start node-red with the following parameters:

node-red --userDir=/root/.node-red/

When it runs as a standalone application, these properties are read from the settings.js file.

The file can be downloaded from

https://raw.githubusercontent.com/node-red/node-red/master/settings.js

The configuration file can be used to change properties like uiHost, uiPort, ui authentication methods... For detail information please check the link below:

https://nodered.org/docs/configuration

Login to system and use wget to download the file to your node-red userDir.

# wget --no-check-certificate https://raw.githubusercontent.com/node

-red/node-red/master/settings.js

Note: After change the setting in the file, it will need to restart node-red to take effects.

## 8.3.4 AUTO START NODE-REDS

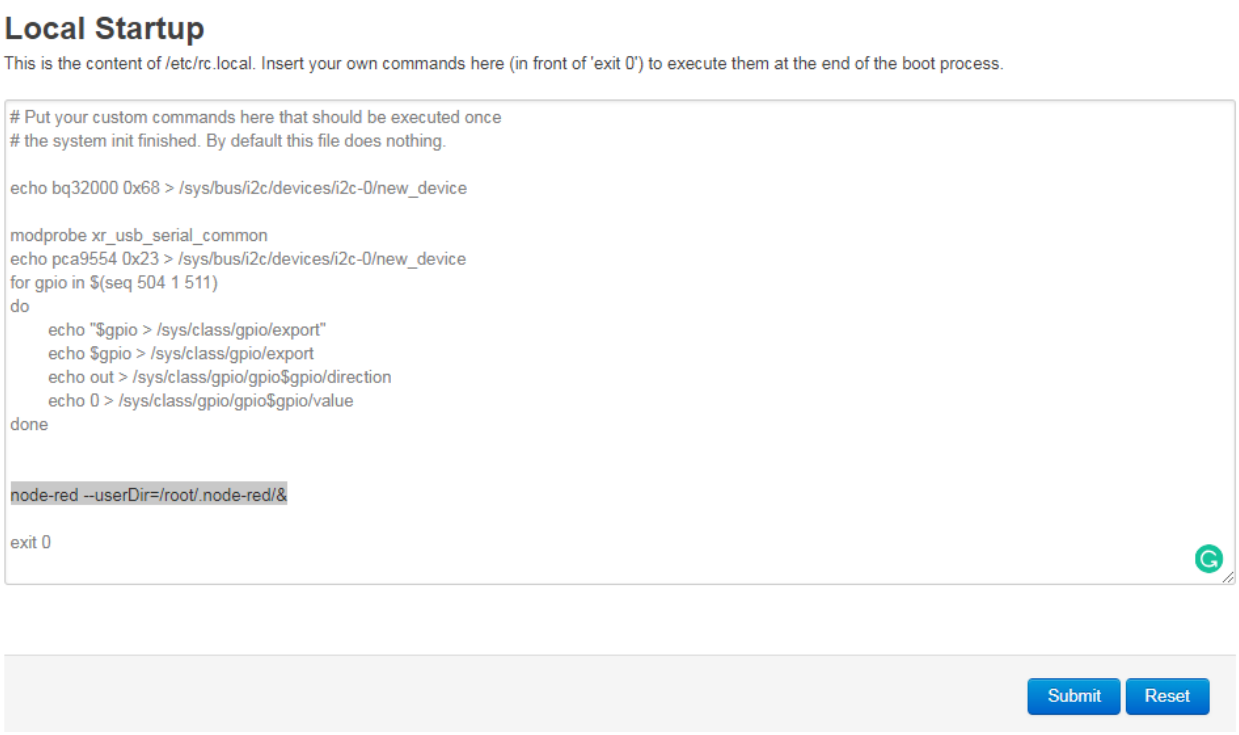
To auto start node-red after system startup, add one line in the /etc/rc.local

node-red --userDir=/root/.node-red/ &

```
root@LEDE:/# vi /etc/rc.local
root@LEDE:/# cat /etc/rc.local
# Put your custom commands here that should be executed once
# the system init finished. By default this file does nothing.

echo bq32000 0x68 > /sys/bus/i2c/devices/i2c-0/new_device

modprobe xr_usb_serial_common
echo pca9554 0x23 > /sys/bus/i2c/devices/i2c-0/new_device
for gpio in $(seq 504 1 511)
do
        echo "$gpio > /sys/class/gpio/export"
        echo $gpio > /sys/class/gpio/export
        echo out > /sys/class/gpio/gpio$gpio/direction
        echo 0 > /sys/class/gpio/gpio$gpio/value
done


node-red --userDir=/root/.node-red/&

exit 0
root@LEDE:/#
```

**Auto Start the Node-Red from Web GUI**

Web -> System->Startup




Add “node-red --userDir=/root/.node-red/ &”, it **MUST** have the "&" at the end of command in order to start the function in background. Click Submit to apply the command.

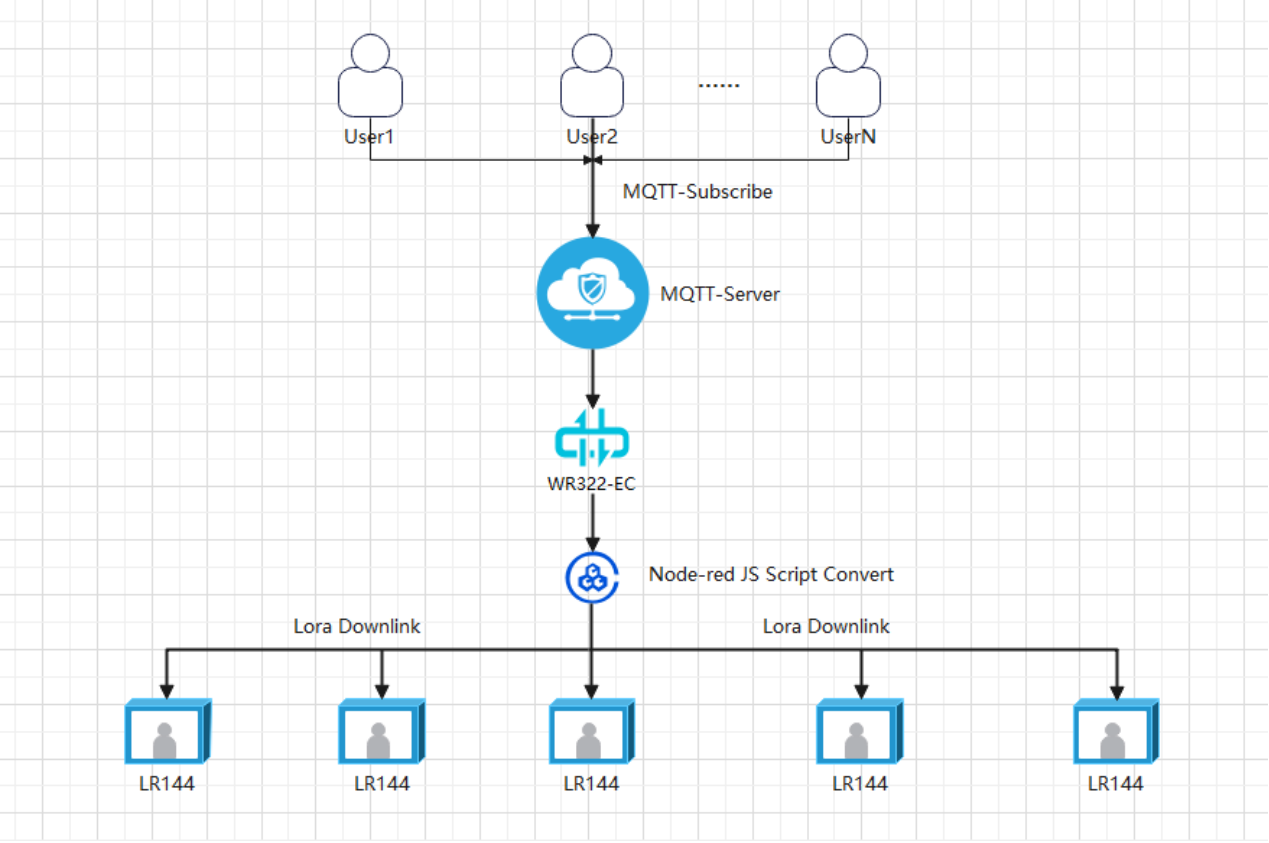
## 8.3.5 WR322 & LR140/144 Join LoRaWan Network（not support）

The following flow-chart describes the system configuration procedure between WR322GR-EC-LoRaWan Gateway and LoRa Wan end-node device (ex. LR140/144).

Due to the LoRaWan Gateway router -WR322GR-EC-LoRaWan has embedded a Network Server and an Application server in one hardware platform. Therefore, users need to perform different function settings through different User operating interfaces that are supported by different TCP service port number and co-configure with end-node devices (ex. LR140/144).

After the device parameter configuration is successful, users can use MQTT to issue instructions to WR322 to control the LR144 related parameters, making it convenient for users to manage and set the end node device.

*Only LR144 supports downlink control, LR140 does not support it.




**1. System Hardware Interface** – Ethernet Port ( LAN, WAN) Configuration, Monitoring

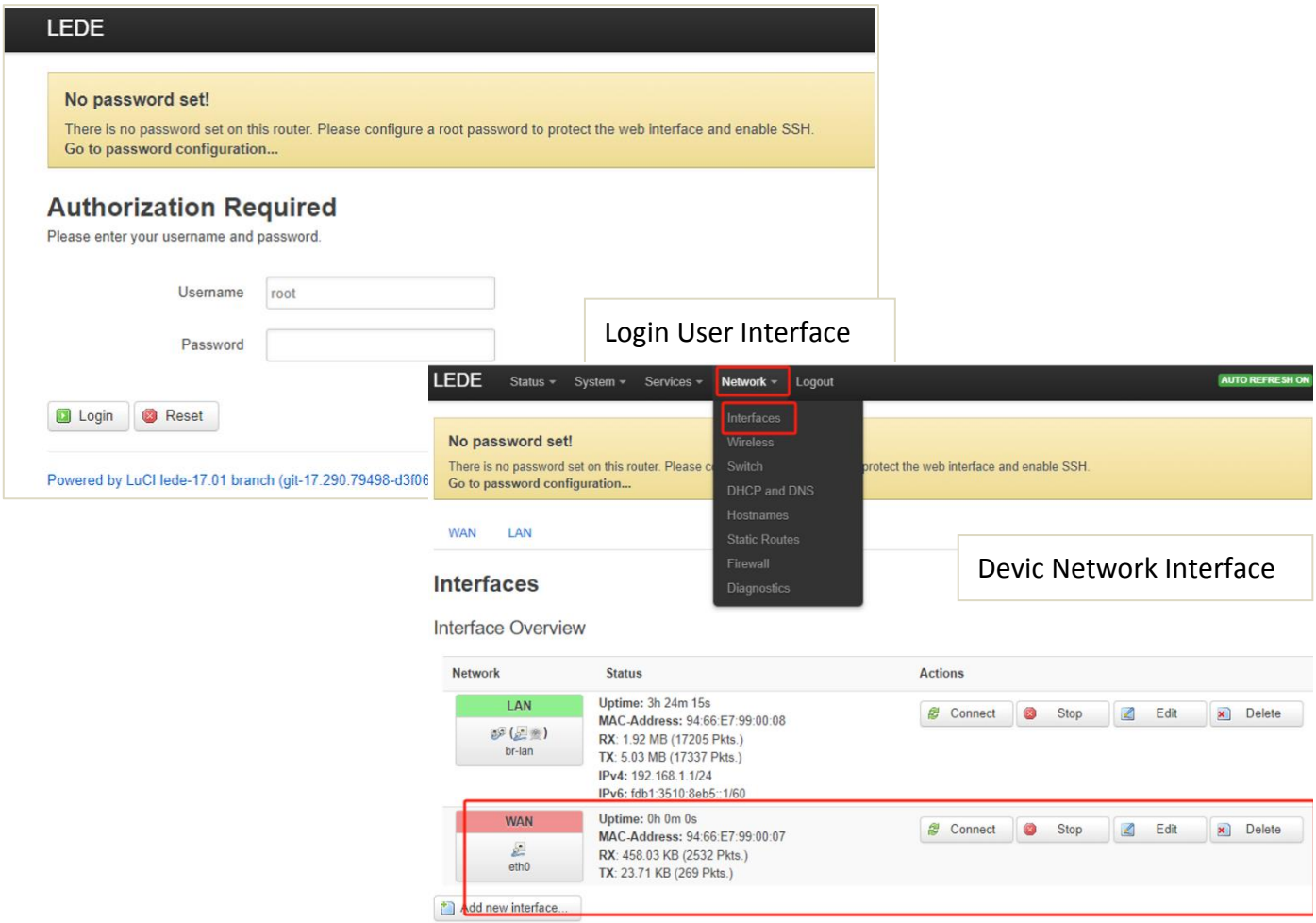
WAN Port: RJ-45 Port #1 – Local Management

LAN Port: RJ-45 Port #2

System Device Default IP Address: **192.168.1.1**

Login User Name: **root**

Login Password: null (default without password)




**2. LoRaWan Gateway & Network Server Configure**

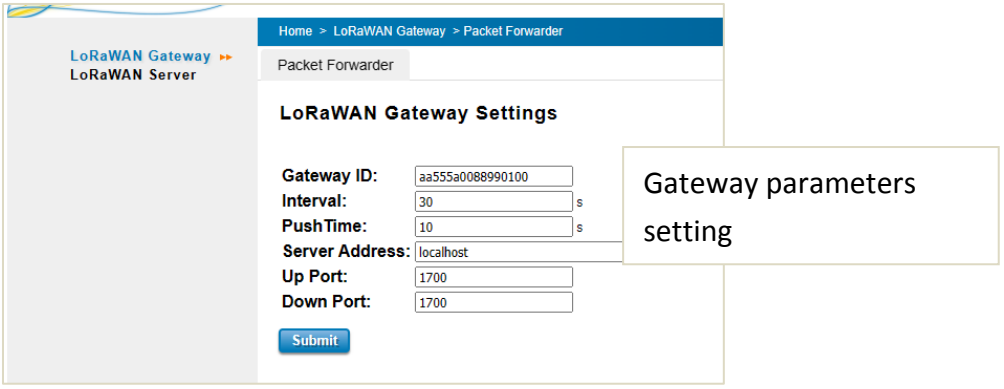
Establish a LoRaWan Network System.

The system embedded LoRaWan Gateway module when shipping. It has adopted suitable LoRaWan module that compliance your country region with properly frequency.

The Hyper-Link IP address and TCP service port number of Gateway & Network Server is **192.168.1.1:8088.** The Web UI show as following 2.1 “Gateway Parameters Setting”

**2.1 Gateway Setting**

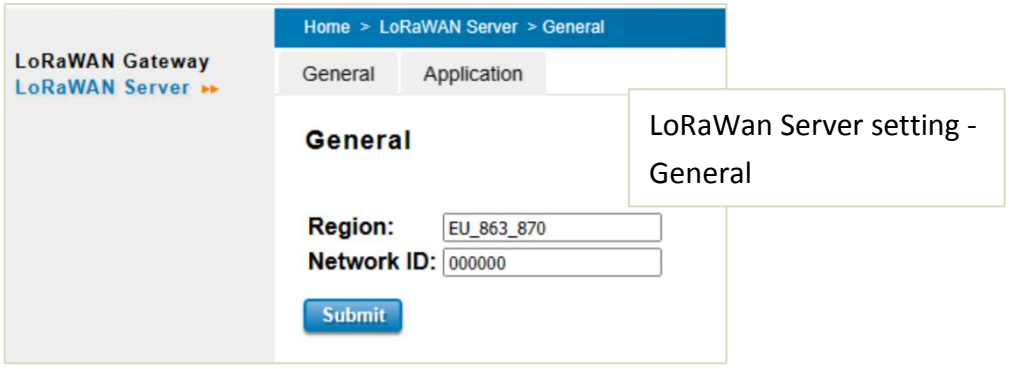
All of the parameters are default setting, any new configure should be saved into system by click the “Submit”




button.

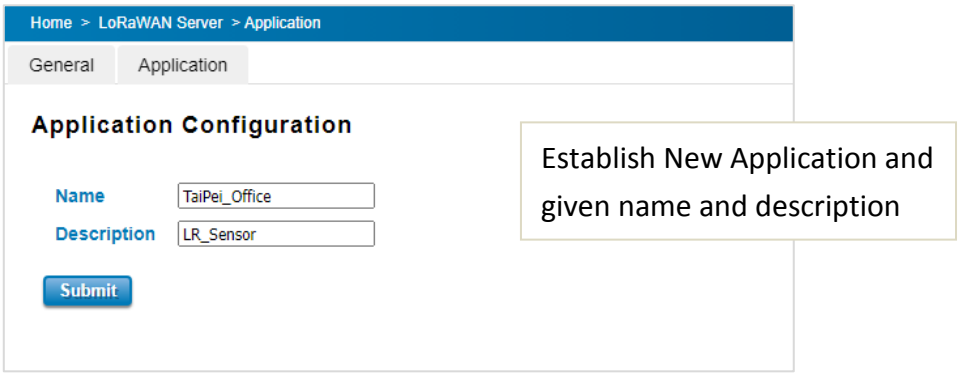
### 2.2 Server Setting - General

The following shows the LoRaWan Network Server Setting, it shows the current LoRaWan module compliance with LoRa Wan channel plan “EU863~870”, and the current Network I.D. is “0000000”. Users may need to change different Network I.D. for the LoRaWan signal distinguish to avoid communication congestion and collision when installing several LoRaWan Gateway Devices.




#### 2.2.1 Server Setting – Add a new Application

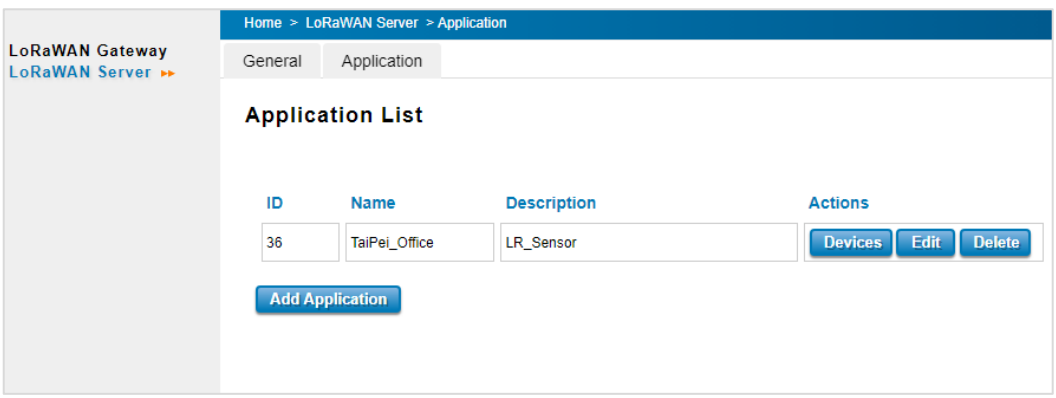
After the Network Server is configured, the user needs to establish the application. The following show the application Name and Description for easy recognition.




Name: the application name – TaiPei_Office
Description: detail information about this application which going to add. – LR_ Sensor

After configuring both of Name and Description, click the “Submit” icon to apply the new application.

The following show the application listing after submits new application.



Ther are 3 Action icons to edit each application rule for the LoRaWan End-Node device.

**ID**: random number system given for Application

**Devices**: Configure the Remote LoRaWan End-Node device parameters of current application.

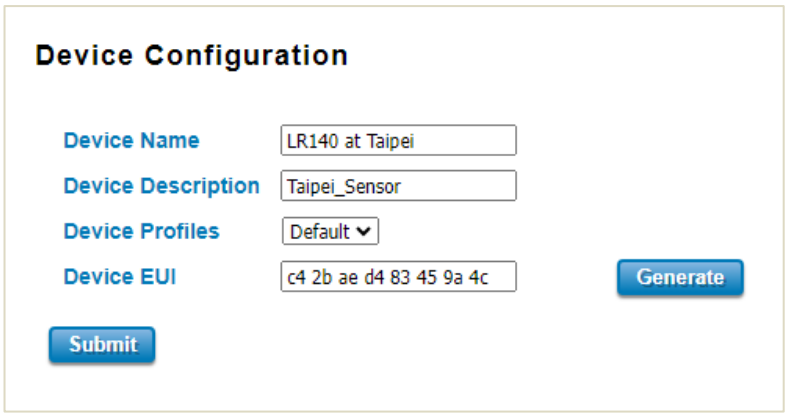
**Edit**: Edit Current configuration.

**Delete**: Delete current application.

**Add Application**: Add a new application.

### 2.2.2 Configure the LoRa End-Node Device of the Application

Once click the “Edit”icon, the Device Configuration UI will show as following:



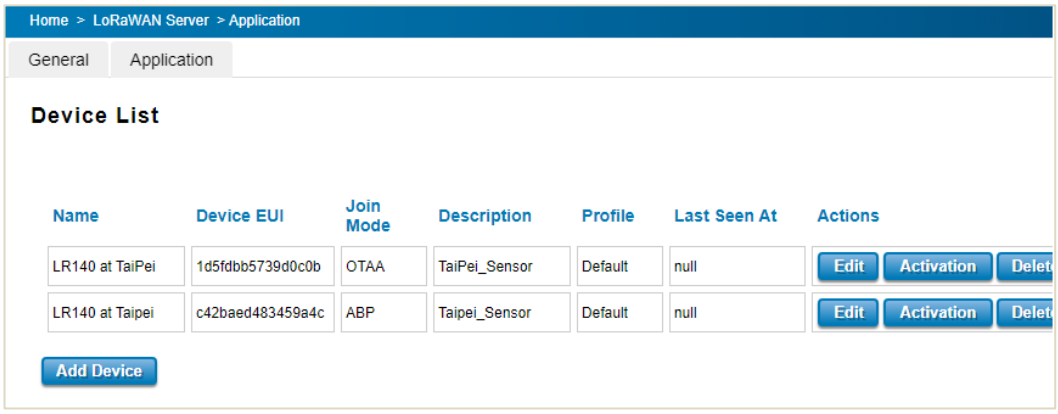

**Device Name**: the name of remote LoRaWan End-Node device. (LR140 at Taipei)

**Device Description**: detail information of the device. (Taipei_Sensor)

**Device EUI**: 64 bit unique identifier address for LoRaWan End-Node device. The Device EUI address will belong to the LoRaWan end-node device of the current application. It will apply to End-node device for network recognition. The Device EUI should be generate by LoRaWan Gateway/Router and copy to the end-node device for identify.

Click “ **Generate**” to generate a new Device EUI for End-node device joint network.

After click the “Submit”, the UI will be update and show the device list as following:




In the UI, it shows the configuration of each device. Also, 3 function icons for detail configure, user can modify the join-mode, description and show last time of seen on the LoRaWan network.

**Join Mode**: Activation of an end-device can be achieved in two ways, either via Over-The-Air Activation (**OTAA**) or via Activation by Personalization (**ABP**)

**Device EUI (DevEUI)**: The Device EUI is a global end-device ID in IEEE EUI64 address space that uniquely identifies the end-device. DevEUI is the recommended unique device identifier by Network Server(s), whatever activation procedure is used, to identify a device roaming across networks.

**For OTAA devices, the DevEUI MUST be stored in the end-device before the Join procedure is executed. ABP devices do not need the DevEUI to be stored in the device itself, but it is recommended to do so**.

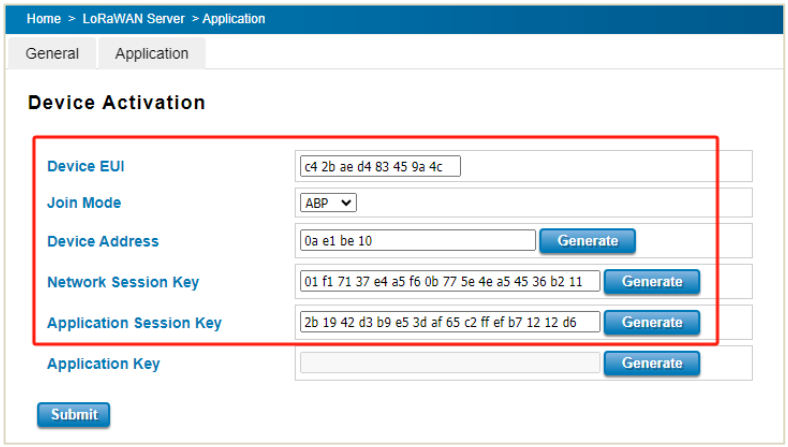
Click "**Activation"** icon of the Device list, the UI will get into Device Activation mode, and support 4 generate icons for **Device Address**, **Network Session Key** and **Application Session Key** for network joint and should be applied on the End-Node devices.

**The Join Mode of LoRaWan Gateway Setting parameters:**

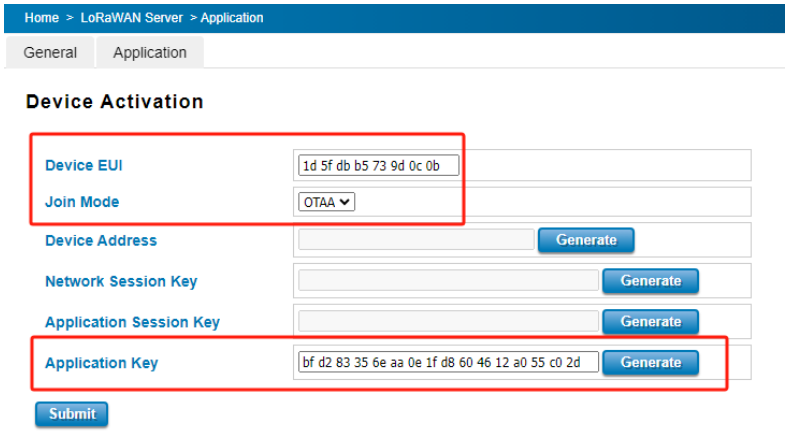
| Join Mode | DeviceEUI | Device Address | NetworkSessionKey | APP_EUI | ApplicationSessionKey | APP_Key |
|---|---|---|---|---|---|---|
| ABP | - | Mandatory | Mandatory | - | Mandatory | - |
| OTAA | Mandatory | - | - | | - | Mandatory |

**There two Join-Modes, ABP and OTAA. Both of Users Interfaces captured as following**.

(1) **ABP Mode**: the **Device Address, NetworkSessionKey**, **Application Session Key** are mandatory. The Application key is not mandatory for end-node device when ABP join mode.




(2) **OTAA Mode**: In OTAA join mode, there are 2 parameters are mandatory, **Device EUI, Application Key** for end-node device join in OTAA mode.



### 2.2.3 Activate the LoRaWan End-Node Device – LR140/144

In a LoRaWn network, each end-device has to be personalized and activated.

Activation of an end-device can be achieved in two ways, either via **OTAA** (Over-The-Air Activation) or via **ABP** (Activation By Personalization).

**It is recommend configure the LoRawan Gateway and LoRawan End node together. During the setting, some parameters need duplicate from Gateway and paste to LoraWan End node setting.**

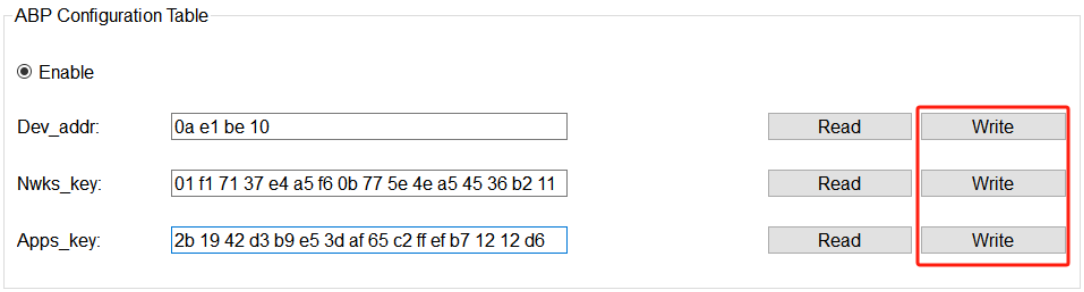
| Join Mode | DeviceEUI | Device Address | NetworkSessionKey | APP_EUI | ApplicationSessionKey | APP_Key |
|---|---|---|---|---|---|---|
| ABP | - | Mandatory | Mandatory | - | Mandatory | - |
| OTAA | Mandatory | - | - | | - | Mandatory |

**End-Node Device (LR140/144) Join LoRaWan Gateway in ABP Mode**

The following shows the configure user interface of LR140/144 in ABP mode:

Duplicate the **DeviceAddress**, **NetworkSessionkey** and **Application Session Key**, and then paste to the configure user interface of end-node device.

The following diagram, the end-node device is joined to LoRaWan Network in ABP mode.

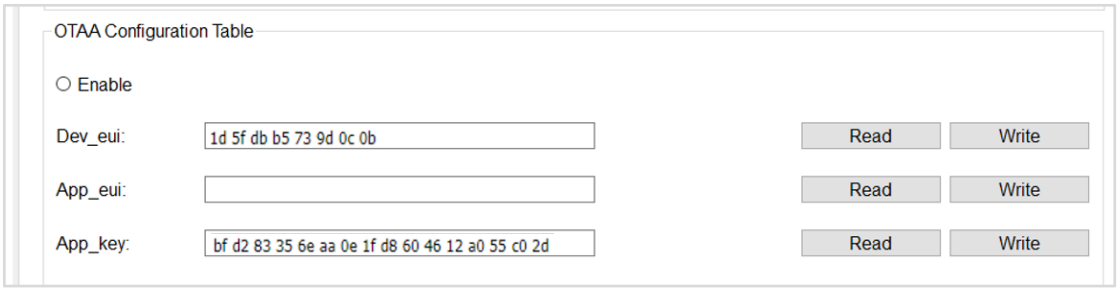



**End-Node Device (LR140/144) Join in OTAA Mode**

The following diagram, the end-node device is joined to LoRaWan Network in OTAA mode.

| Join Mode | DeviceEUI | Device Address | NetworkSessionKey | APP_EUI | ApplicationSessionKey | APP_Key |
|---|---|---|---|---|---|---|
| ABP | - | Mandatory | Mandatory | - | Mandatory | - |
| OTAA | Mandatory | - | - | | - | Mandatory |

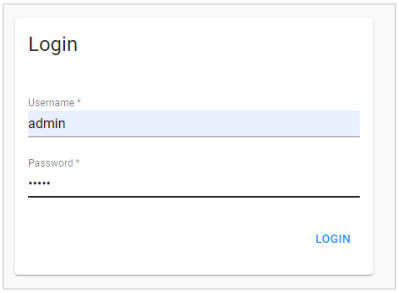
Duplicated the **Device EUI (Dev_eui)** and **Application Key (App_key)** from the User Interface of WR322EC-LoRa and paste to the configure user interface of end-node device, then click “Write” to programming new update information into End-node system.



**1. ChripStack Network Server Check**

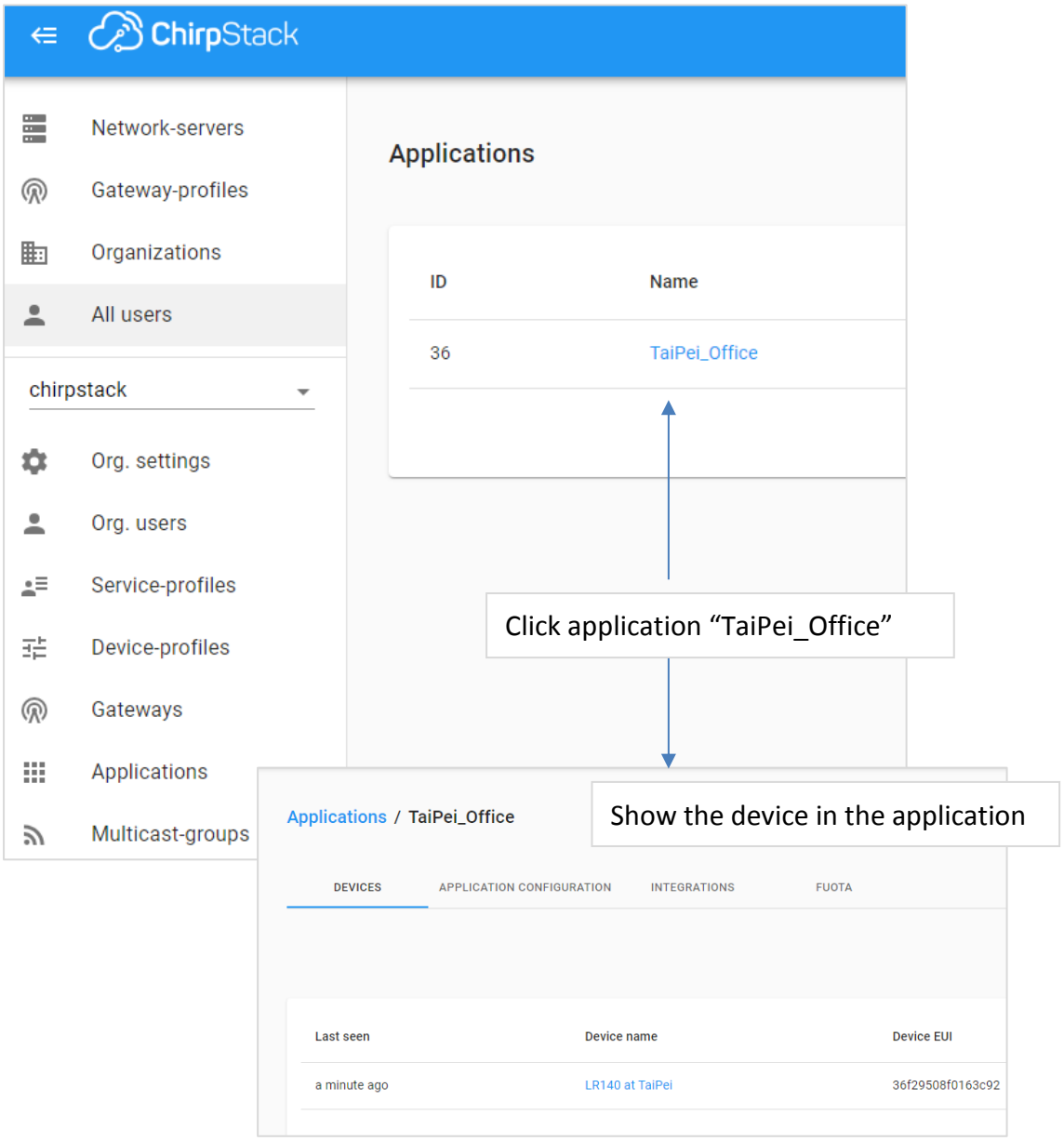
(Suggest operating by software engineer for debug)

The WR322EC-LoRa Gateway embedded network server- ChripStack, user can browsing the default Ip address with 8080 service port to login ChripStack server for LoRaWan Network connection debugging.

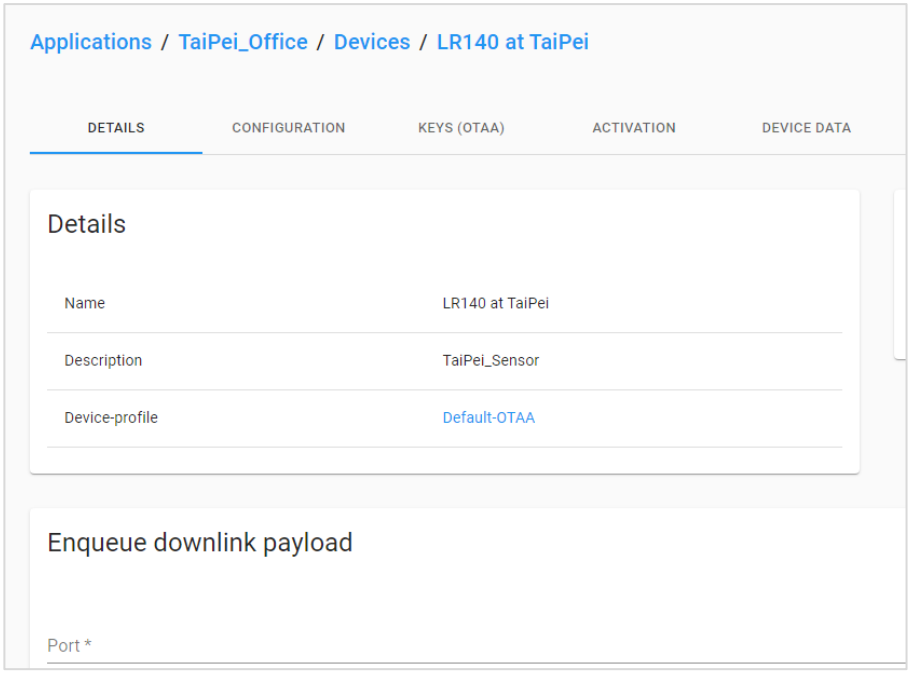



**Login IP: 192.168.1.1:8080**
**User Name: admin**
**Password: admin**

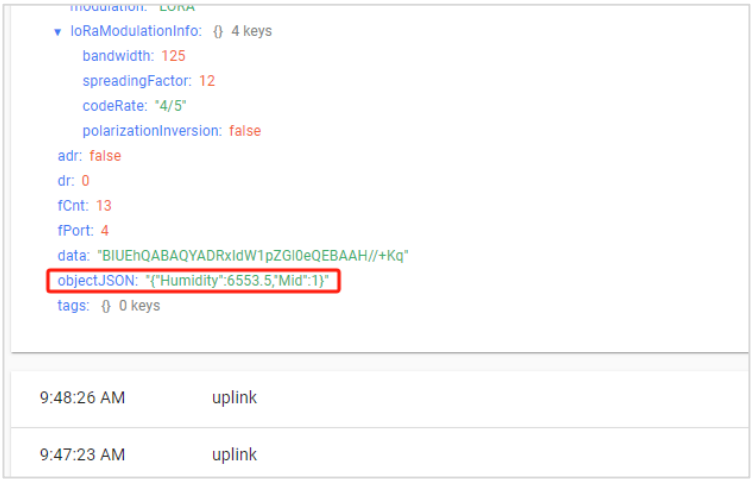
Click the “Application “icon on the left menu to show the application list, and click application Name, it will show all device under the application “TaiPei_Office”



Choose a device set in the http://192.168.1.1:8080/index.asp,here click device name“LR140 at TaiPei” .it will display all device under”TaiPei_Office” application.




Choose top menu bar “Device Data”, wait a moment, it will show a newest message.it will show a humidity value :65535,it represent humidity value is null and mid value is 1 means rtu id is 1.

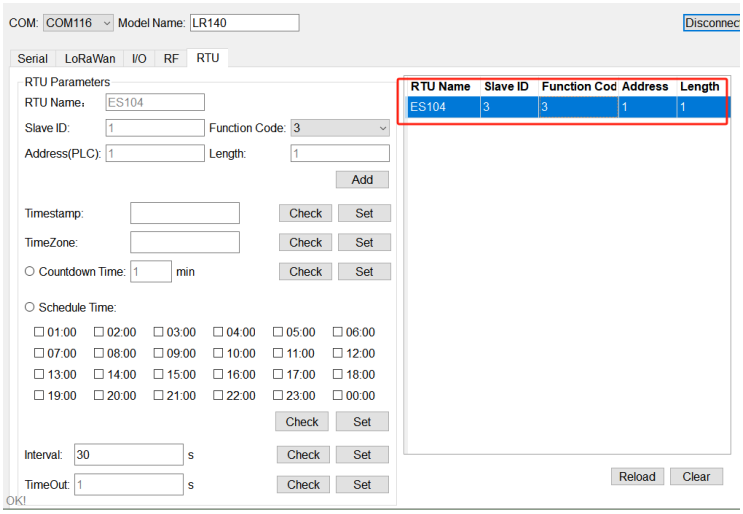


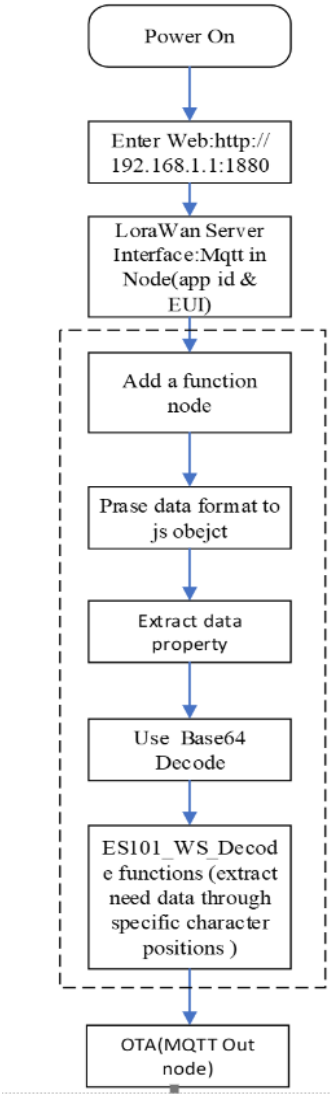
## 2.Node-Red server (data edge computer and ota)

After finish ChripStack setting, then you need enable Node-Red server for edge computing and perform more logical process. The default IP address of Node-Red: **192.168.1.1:1880** without Login name and password.

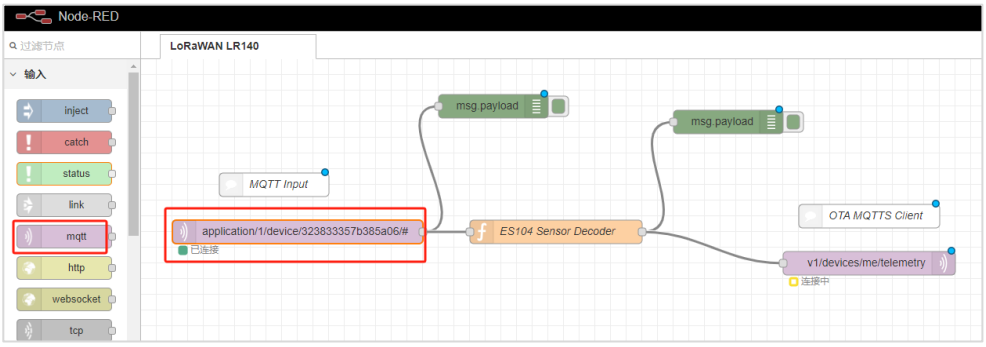
This chapter will explain the Node-Red with LoRa End-node device LR140/144 and environment sensor – ES104 for demonstration.

Step1: Using Lora Utility setting ES104 device RTU reading humidity,
set RTU slave ID=3, function code=3, register address =1, register length =1. (Ex: the LR140 integrated with a T/H sensor)

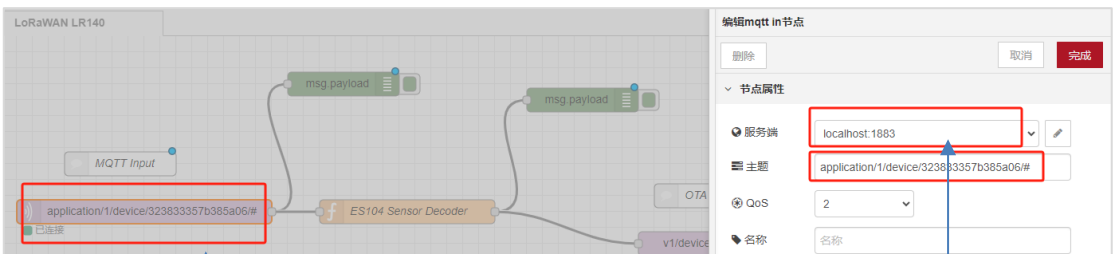


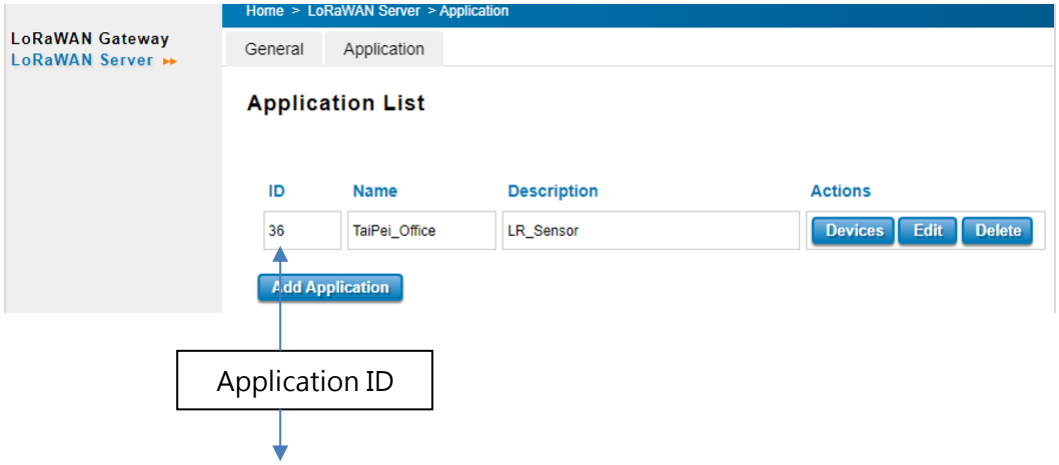

Step 2: Browser:http://192.168.1.1:1880,enter LoraWan edge computer and data ota configuration page. It embedded a default data OTA example.




Step 3: the Node-Red application Server offer a local mqtt input interface, click the icon "application/1/device/323833357b385a06/#"to pull choice the local host 1883, and modify the Topic, the format as:"application/xx(application id)/device/xxxxxxxxxxxxxx(device eui)/#. The Application-id and device-eui should be same as the setting – 2.2.1 Server Setting –Application id and 2.2.1 Device list – Device EUI. The following captured show the configuration.



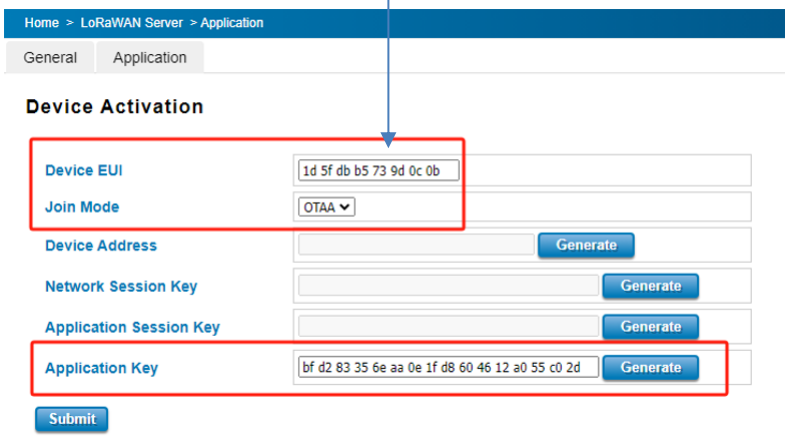
Localhost:1883




Application ID

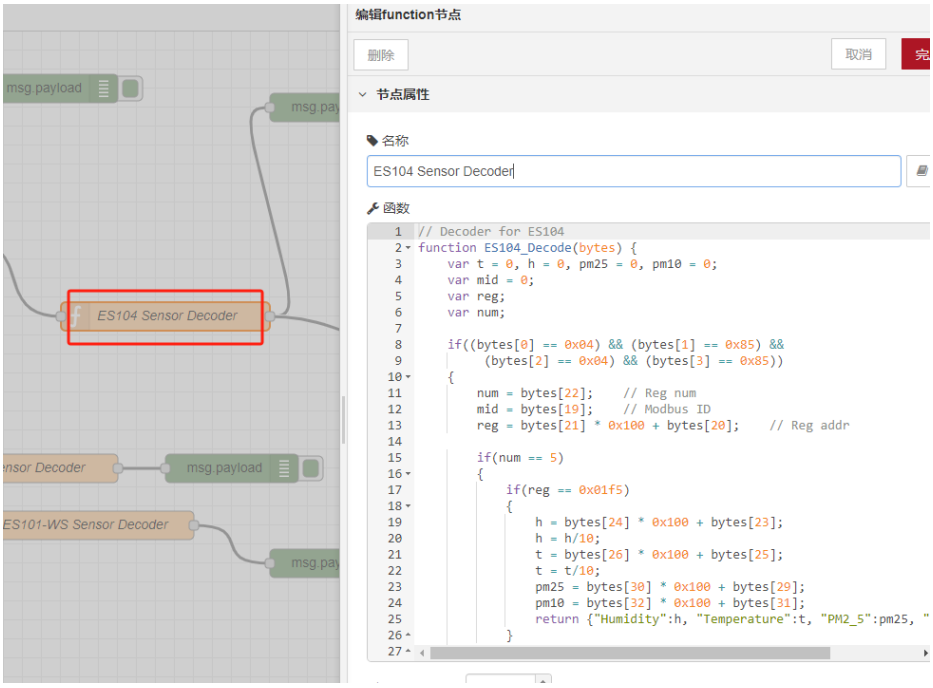
Topic: “application/36/device/1d5fdbb5739d0c0b/#”

Device EUI

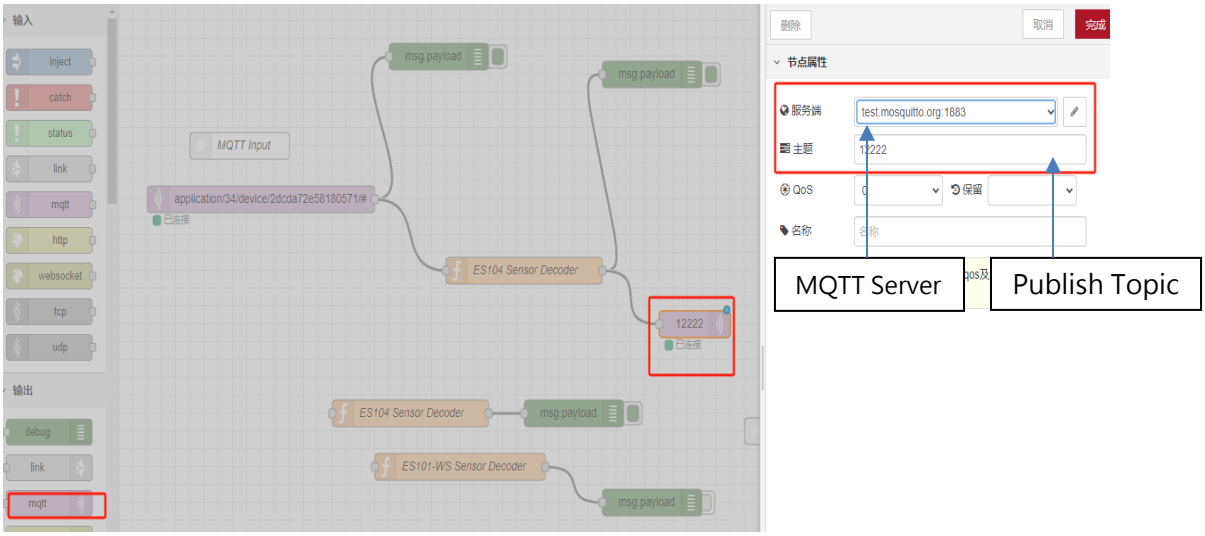



Step 4: after setting mqtt in node, the data enter ‘ES104 Sensor Decoder’ node prased,the purpose of this function node is to decode and output the values of the RTU register set on the Utility in JSON format. Double click the

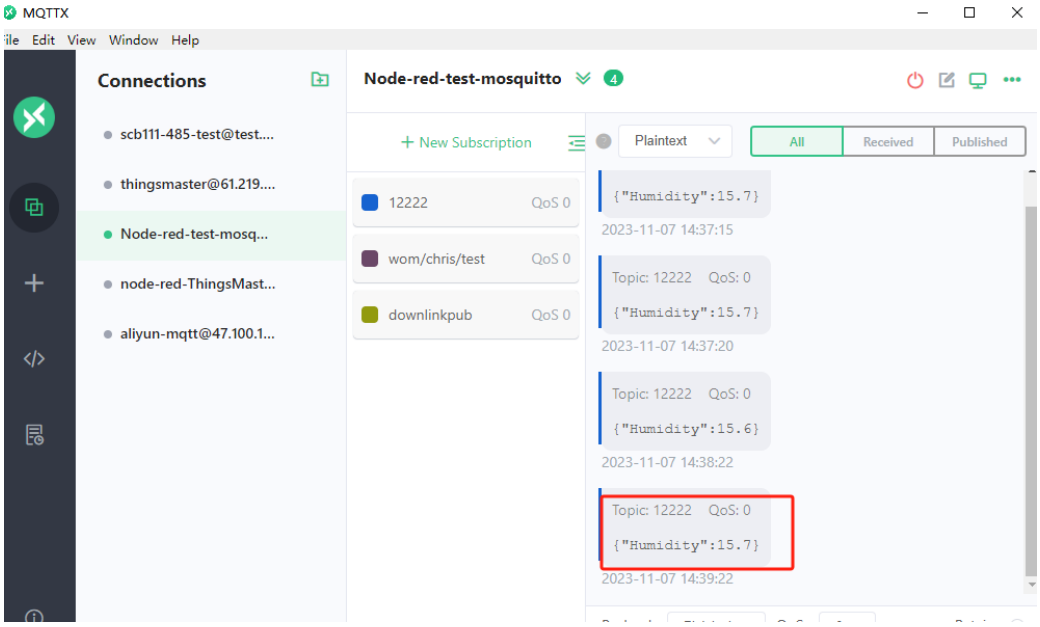
“ES104 Sensor Decoder”, then pop-up dialog for modify the naming, and also explore the data in JSON format.




Step 5: After parsing, the data will send OTA platform, in this case, add a mqtt out node , type-in mqtt server address and topic of publish.

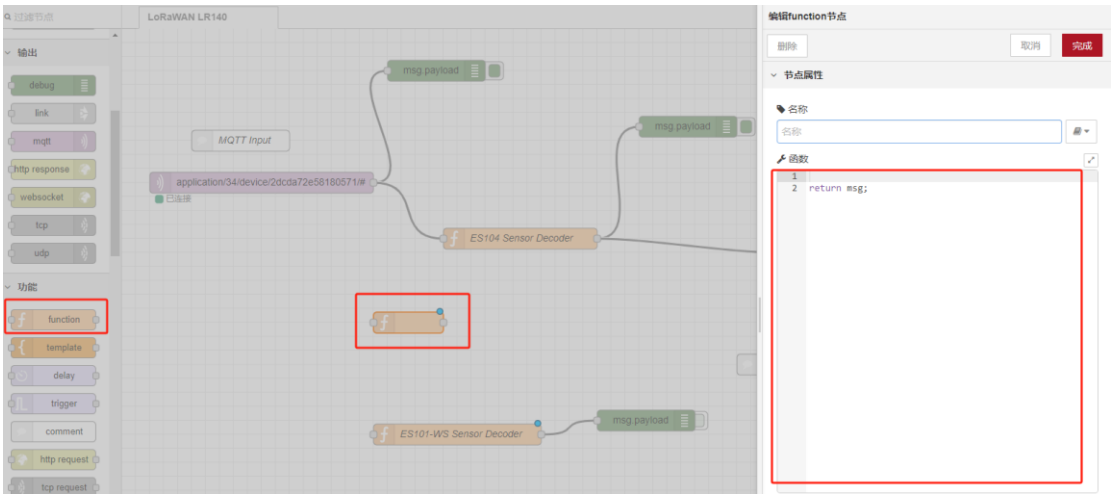


Open mqtt.x client, add a mqtt suscribe , the mqtt server and topic correspond with node-red mqtt out node. (Establish MQTTx connection for client)
the following shows the LoRa End-Node device polling data and send to WR322-LoRaWan and publish to MQTTx server in JSON format.

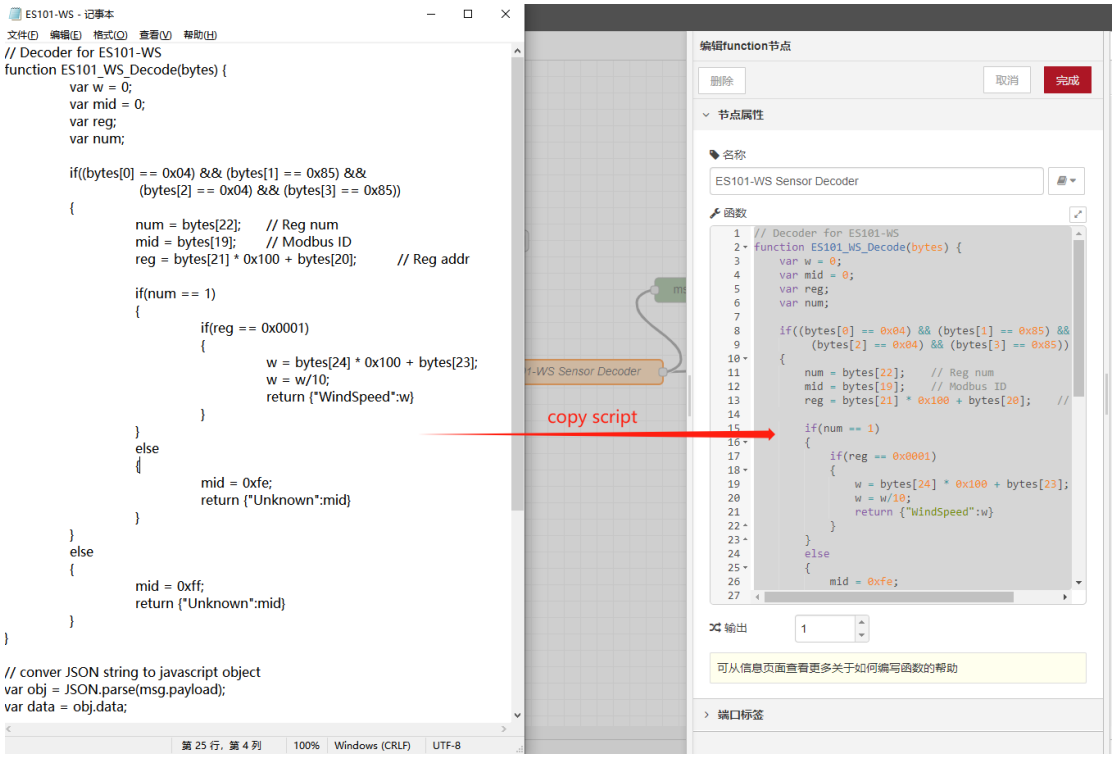



**How to create a new function node?**

If user need add a new series of function node which contains edge computer and prase LoraWan data,user can add a function node from left bar menu,following picture shows.



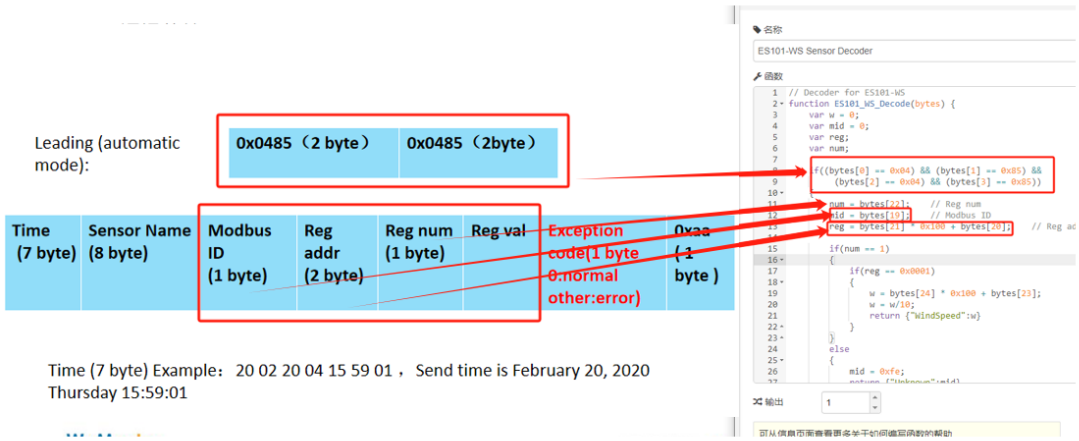

For example,user end-node device connect a ES101 which is a wind speed sensor,the function node script copyed from external text which offered by Womaster.




In this script, there are several main steps:

1. Parse the received JSON string into a JavaScript object,
2. Assign the result to obj,
3. Extract the attribute value named data from the obj object.
4. Decode the data string into binary data using Base64, and assign the result to buf.
5. Use a custom function to extract the data in buf through specific character positions.
6. Assign the decoded value to msg,Payload and return value.


It's most important above step is 5 which is custom function, in this function,womaster use a fixed format to tansfer Modbus RTU data.the follow pictures shows.




Each uplink message includes the following formats: **a leading character of 4 bytes 0x485, 0x485, a time of 7 bytes (Example: 0x231108105601, means: November 8, 2023 , 10:56:01), a Modbus ID of 1 byte, a Modbus register addr of 2 bytes, a register number of 1 byte, a register value (the length dependency on reading register number), an Exception code of 1 byte (1 byte 0: normal other: error), 1 byte terminator (0xaa).**

# 9. REFERENCE

1. ser2net(8) – Linux man page
2. iptalbes(8) – Linux man Page
3. Netfilter IPTables Mini Howto
4. Factory Reset

## 9.1 BUSYBOX COMMAND

```
root@LEDE:~# ash


BusyBox v1.25.1 () built-in shell (ash)
```

busybox(V1.25.1): Linux command collection

| File Manager | |
|---|---|
| ***cp*** | copy file |
| ***ls*** | list file |
| ***ln*** | make symbolic link file |
| ***mount*** | mount and check file system |
| ***rm*** | delete file |
| ***chmod*** | change file owner & group & user |
| ***chown*** | change file owner |
| ***chgrp*** | change file group |
| ***sync*** | Sync file system, let system file buffer be saved to hardware |
| ***mv*** | move file |
| ***pwd*** | display now file directly |
| ***df*** | list now file system space |
| ***mkdir*** | make new directory |
| ***rmdir*** | delete directory |

| Editor | |
|---|---|
| ***vi*** | text editor |
| ***cat*** | dump file context |
| ***zcat*** | compress or expand files |
| ***grep*** | search string on file |
| ***cut*** | get string on file |
| ***find*** | find file where are there |
| ***less*** | View a file or list of files. |

| | |
|---|---|
| ***test*** | test file exist or not |
| ***sleep*** | sleep(seconds) |
| ***echo*** | Echo string |
| ***awk*** | Pattern scanning and processing language. |
| ***sed*** | perform text transformations on a file or input from a pipeline. |
| ***xargs*** | execute a specified command on every item from standard input. |

| **Archival Utilities** | |
|---|---|
| ***bzip2/*** | Compress/Uncompress bzip FILE |
| ***gzip/gunzip*** | Compress/Uncompress FILE with maximum compression. |
| ***tar*** | Create, extract, or list files from a tar file |

| **System logging** | |
|---|---|
| ***logger*** | Utility to send arbitrary text messages to the system log |
| **Network** | |
| **ping** | ping to test network |
| **arping** | Ping host by ARP packets |
| **nslookup** | Tool to query Internet name servers |
| **traceroute** | Utility to trace the route of IP packets |
| **wget** | Utility for non-interactive download of files from HTTP, HTTPS, and FTP servers. |
| **udhcpc** | DHCP client |
| **route** | routing table manager |
| **netstat** | display network status |
| **Ifconfig** | set ip address and configure network interfaces |
| **Logread** | Display all of the system log |

| **Others** | |
|---|---|
| **dmesg** | dump kernel log message |
| **zcat** | dump .gz file context |
| **mknod** | make device node |
| **free** | display system memory usage |
| **date** | print or set the system date and time |
| **env** | run a program in a modified environment |
| **clear** | clear the terminal screen |
| **reboot** | reboot / power off/on the server |
| **halt** | halt the server |
| **du** | estimate file space usage |

| | |
|---|---|
| **kill/killall** | Send specified signal to the specified process or process group |

For complete command usage and explanation, please refer to following website:

http://www.busybox.net/downloads/BusyBox.html

| Version | Modification | By | Date |
|---|---|---|---|
| V1.0 | Release | Yohan | 17/01/2019 |
| V1.1 | - Update the Cellular section<br>- Update the Node-red part (7.3.3 & 7.3.4) | Yohan | 25/02/2019 |
| V1.1.1 | 1. Add WR312/322GR-EC-LORAWAN model name and introduction<br>2. Add 7.3.5 part, WR322 & LR140 Join LoRaWan Network configuration information | Ann | 14/03/2024 |
| V1.1.2 | 1.1:Modify QCA9558 to MT7621<br>2.1.2：Modify TTL baudrate to 57600<br>2.2：add command for saving network setting<br>3.4.2：update NTP client command<br>4.1：update gpio for sim detection;<br>Add raw_ip setting for cellular<br>6.1：update wr-uart-ctl setting<br>6.2：update command to remount SD card<br>7.2.3：update gpio table | Jerry.lian | 30/5/2024 |
| V1.1.3 | Update chapter 4.1 and 4.3 | Jerry.lian | 22/8/2024 |
| V1.1.4 | Add chapter 2 | Ann | 27/9/2024 |