



## **Instructions for GL-MiFi Developer**

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GL Tech.

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# 1. The hardware

## 1.1. Specifications

Mifi dev board is developed using Domino Core and Industrial PCIe 3g/4g modules, targeting as industrial grade applications and hobbyist projects. We are continuing to improve the product so the final product may differ from the pictures.



CPU	Atheros AR9331, @400MHz
Memory	DDR 64MB/ FLASH 16MB
Interfaces	1 WAN, 1 USB2.0, 1 micro USB (power)
Frequency	2.4GHz
Transmission rate	150Mbps
Tx power (maximum)	18dBm
Protocol	802.11 b/g/n
Power supply	5V/1A
Power consumption	<2W
Dimension	60*60*15mm, 130g

## 1.2. Interfaces

MiFi board provides abundant interfaces. The buttons and LEDs may not be well configured in the default firmware.

### Power Button (only for battery powered):

- Press to show battery power status
- Long press to turn on/off the board

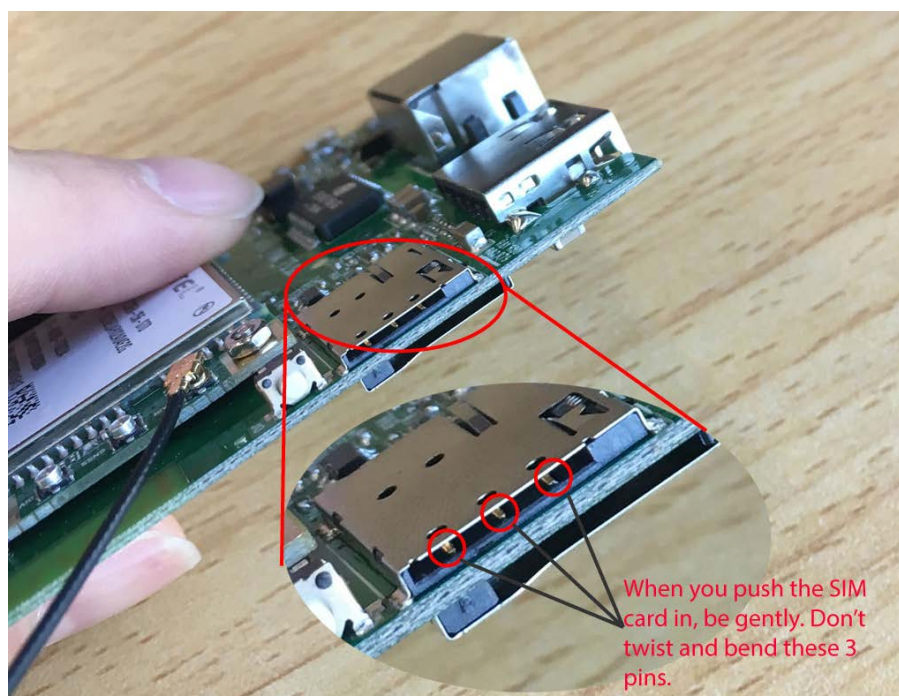
### Reset button:

- Configurable in OpenWrt scripts at `/etc/rc.button/reset`

### SIM slot:

- Nano SIM slot, please use a nano SIM card, not trimmed micro SIM card, which may be a little thick

- Gently insert the SIM card to the slot. It should slip in easily. Don't push with force, which may damage the slot.



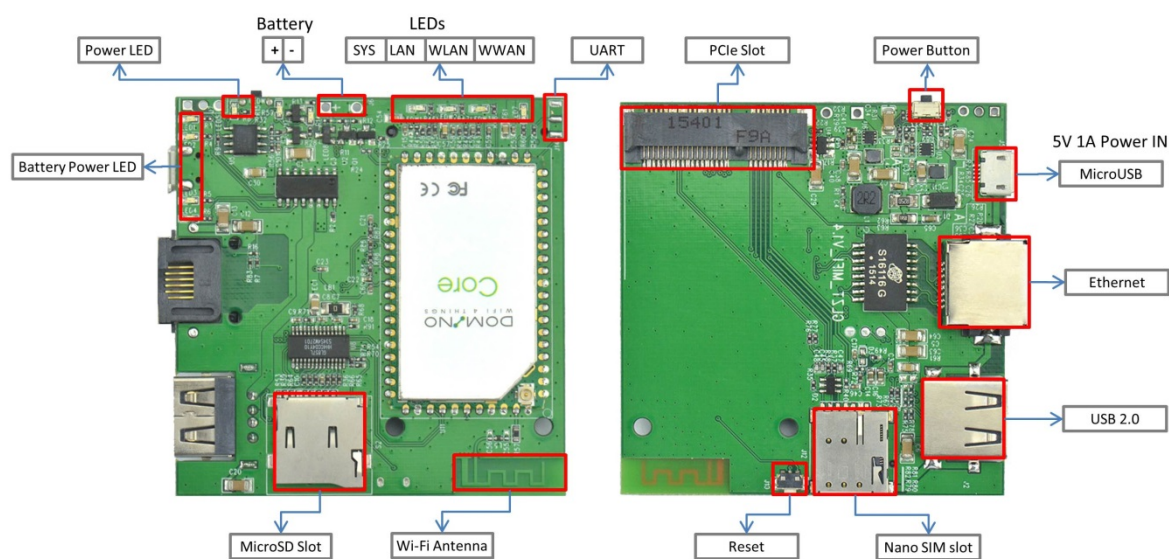
#### Ethernet Port:

- Early version of the firmware configure it as WAN, only used to get IP from routers
- The newest firmware configure it as LAN by default. Plug a cable to it from your computer will get an IP address.



### GL-MiFi (v1)

Model	GL-MiFi
CPU	AR9331 400MHz
Size	63.4x64.9 mm
Protocol	802.11 b/g/n
Weight	130g
Flash	16MB
RAM	64MB DDR
Max Tx Power	18dBm
Power	<2W



## 2. Compatible 3g/4g modules

GL-Mifi is compatible with most PCIe 3G/4G modules. We have three modules tested.

- 3G: Quetel UC20,
- 4G: Quetel EC20, HUAWEI ME909s-821

During the first time when you use the MiFi board:

1. Plug your module in the PCI-E slot of GL-MiFi
2. Insert your Nano SIM card to the SIM card slot
3. Power the board up using MicroUSB power input, or using 3.7V LiPo batteries.
4. Connect to the board using Ethernet cable or using Wi-Fi. The default SSID should be Domino-xxx.
5. If possible, solder the UART serial connector and connect via an USB-UART adapter.
6. SSH to the board 192.168.1.1 or using serial, check if the modem has been recognized.

`ls /dev/ttyUSB*`

7. If the console displays `tttyUSB0`, `tttyUSB1`, `tttyUSB2`, `tttyUSB3` and `tttyUSB4` (as figure shown below), that means GL-MiFi identified the module and we can then configure the MiFi.
8. `tttyUSB4` is not shown in QMI mode. It will be recognized as `/dev/cdc-wdm0`

```
root@domino:/# ls /dev/ttyUSB*
/dev/ttyUSB0 /dev/ttyUSB1 /dev/ttyUSB2 /dev/ttyUSB3 /dev/ttyUSB4
```

For Quetel EC20, and UC20, the port should be used as:

`/dev/ttyUSB0` DM  
`/dev/ttyUSB1` GPS NMEA message output  
`/dev/ttyUSB2` AT commands  
`/dev/ttyUSB3` PPP connection or AT commands  
`wwan0` (QMI mode) USB network adapter

For Huawei ME909s-821, the data port is `/dev/ttyUSB0`

Name	Data Port	AT Command Port
Quetel EC20	<code>/dev/ttyUSB3</code>	<code>/dev/ttyUSB2</code>
Quetel UC20	<code>/dev/ttyUSB3</code>	<code>/dev/ttyUSB2</code>
Huawei ME909s-821	<code>/dev/ttyUSB0</code>	
Huawei EM770	<code>/dev/ttyUSB2</code>	<code>/dev/ttyUSB0</code>

## 3. Quick start

### 3.1. Prepare

You need to make sure you have the correct modem model. For example, if you are using a 4GLTE SIM card, choose EC20, not UC20.

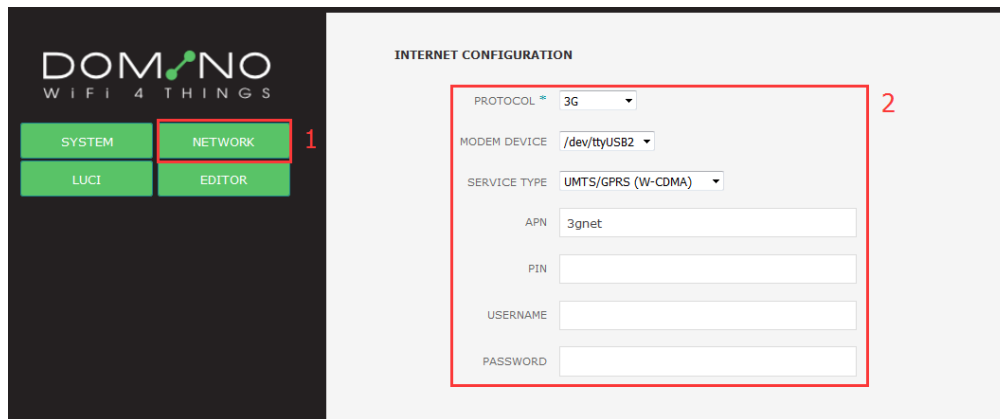
You need to get some basic information from your telecom service provider, including:

- **Service Type:** UMTS, EVDO or LTE
- **APN:** This is generally needed
- **Username and password:** may not be necessary
- **Dial number:** may not be necessary

### 3.2. Web Setting

After you connect to the board using Wi-Fi or Ethernet cable, you can using a browser to access <http://192.168.1.1>. We have a WebUI so that you can set some basic parameters.

Click the “NETWORK” link on the left and you can set the parameters. In the UI, there may be only UMTS and EVDO to select. If you want to setup LTE connection, using SSH or UART.

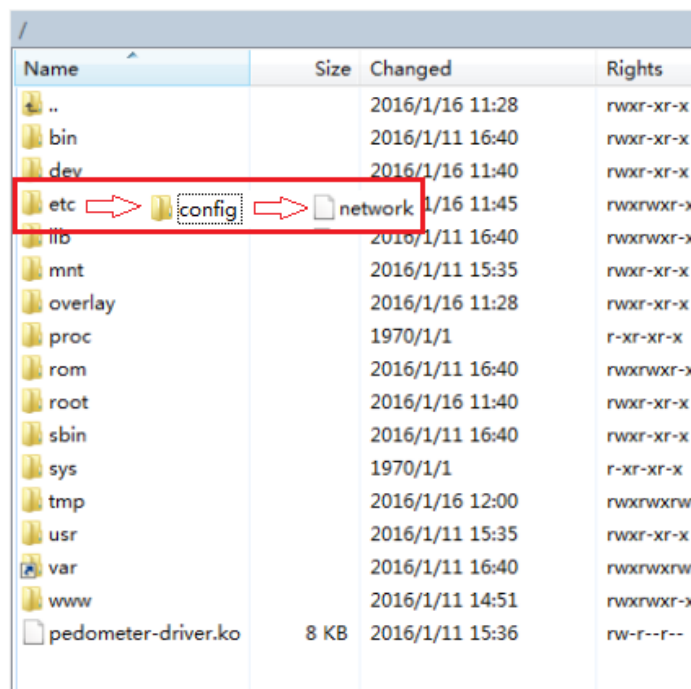


### 3.3. Using winscp via SSH

If you are using Windows, winscp is a good tool to manipulate the settings.

First connect to the board using winscp.

Second, modify file content directly. If you want to modify network configuration, “/etc/config/network” is the correct file to modify.



### 3.4. Using vi via SSH/serial

If you are using Linux or OSX, you can use ssh directly or do this using the serial console.

```
ssh root@192.168.1.1
```

If you have set up a password, use the password to login. If you didn't set up a password, don't use ssh, use telnet instead.

```
telnet 192.168.1.1
```

Using "vi" to modify network configurations:

```
root@domino:/#  
root@domino:/# vi /etc/config/network  
root@domino:/#  
  
config interface 'wan'  
    option ifname 'eth0'  
    option hostname 'Domino-7a2'  
    option proto '3g'  
    option username 'ctnet@mycdma.cn'  
    option service 'fdd-lte'  
    option apn 'ctlte'  
    option password 'vnet.mobi'  
    option device '/dev/ttyUSB3'  
  
config interface 'wan6'  
    option ifname '@wan'  
    option proto 'dhcpv6'
```

For 4G-LTE, change the service to "fdd-lte", for 3G umts, change service to "umts", for evdo, change to "evdo".

After you change the settings, restart the network:

```
/etc/init.d/network restart
```

If you are sure that your settings are correct, after restarting the network or restarting the router, you keep getting "error -2" error messages, please unplug the power then plug the power again, which does the trick.

### 3.5. Change the Ethernet to WAN or LAN

If you board only has one Ethernet Port (V1), it can be configured as WAN or LAN.

Change the settings by editing /etc/config/network

#### Change to WAN

```
config interface 'lan'  
# option ifname 'eth0' #comment or delete this line
```

```
config interface 'wan'  
    option ifname 'eth0'  
    option proto 'dhcp'
```

#### Change to LAN

```
config interface 'lan'  
    option ifname 'eth0'  
    option ...
```

```
config interface 'wan'
# option ifname 'eth0' #comment or delete this line
option proto 'dhcp'
```

### 3.6. Check 3G/4G status

If the device connected to the 3G/4G network successfully, you should be able to see “3g-wan” network interface. If it has an IP address now, it means you are connected now.

```
root@dominomifi:/# ifconfig 3g-wan
```

```
3g-wan  Link encap:Point-to-Point Protocol
        inet addr:10.72.216.206  P-t-P:10.64.64.64  Mask:255.255.255.255
        UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
        RX packets:2217 errors:0 dropped:0 overruns:0 frame:0
        TX packets:1661 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:3
        RX bytes:2600234 (2.4 MiB)  TX bytes:152126 (148.5 KiB)
```

## 4. AT command

For UC20/EC20, `/dev/ttyUSB2` is for AT commands. First send the commands to the port, then get the output from the port. For example:

```
echo -e "AT+xxx\r\n" > /dev/ttyUSB2
cat /dev/ttyUSB2
```

### 4.1. Comgt – a quick tool

There is a build-in tool called “comgt” which you can quickly check if you SIM card is registered or not. This should give the correct output before you set up the apn and start network connection.

```
root@dominomifi:/# comgt
Trying list of devices
SIM ready
Waiting for Registration..(120 sec max)
Registered on Home network: "one2free",6
Signal Quality: 14,99
```

### 4.2. Request International Mobile Equipment Identity

Command: `[echo -e "AT+GSN\r\n" > /dev/ttyUSB2]`

See the result: `[cat /dev/ttyUSB2]`

Correct result:

```
AT+GSN
861075021617089
OK
```



If you get the similar number, it means that the connection is OK.

Wrong result:

```
AT+GSN
```

```
ERROR
```

### 4.3. Request SIM'S CCID

Command: `[echo -e "AT+QCCID\r\n" > /dev/ttyUSB2]`

See the result: `[cat /dev/ttyUSB2]`

Correct result:

```
AT+QCCID
```

```
+QCCID: 89860115851079757018
```

```
OK
```

If you get the similar number, it means that the connection of SIM-card is OK.

Wrong result:

```
AT+CCIDI
```

```
ERROR
```

### 4.4. Request IMSI

Command: `[echo -e "AT+CIMI\r\n" > /dev/ttyUSB2]`

See the result: `[cat /dev/ttyUSB2]`

Correct result:

```
AT+CIMI
```

```
460010529708870
```

```
OK
```

Wrong result:

```
AT+CIMI
```

```
ERROR
```

### 4.5. Check Network Registration

Command: `[echo -e "AT+CREG?\r\n" > /dev/ttyUSB2]`

See the result: `[cat /dev/ttyUSB2]`

Correct result:

```
AT+CREG?
```

```
+CREG: 0,1
```

```
OK
```

If you get the similar result, it means that your SIM-card has registered in telecom operators

Wrong result:

```
AT+CREG?
```

```
ERROR
```

## 4.6. Signal Quality Report

Command: `[echo -e "AT+CSQ \r\n" > /dev/ttyUSB2]`

See the result: `[cat /dev/ttyUSB2]`

Correct result:

```
+CSQ: 21,99
```

```
OK
```

This first number—"21" is the result. We usually get the value number is 18~23.

Wrong result:

```
AT+CSQ
```

```
ERROR
```

## 4.7. Query The Currently Selected Network Operator

Command: `[echo -e "AT+COPS?\r\n" > /dev/ttyUSB2]`

See the result: `[cat /dev/ttyUSB2]`

Correct result:

```
AT+COPS?
```

```
+COPS: 0,0,"CHN-UNICOM",6
```

```
OK
```

The currently network operator is ChinaUnicom

Wrong result:

```
AT+COPS?
```

```
ERROR
```

## 4.8. Reset

You can reset the modem using AT command. The modem will be disconnected and connected again.

```
echo -e "AT+QRST=1,0" > /dev/ttyUSB2
```

## 4.9. Other AT Instructions

If you want to know more, please refer [Quectel\\_UC20\\_AT\\_Commands\\_Manual\\_V1.5.pdf](#)

## 5. QMI Mode

The firmware is compiled with QMI drivers and you can use QMI mode. You will see a device called `/dev/cdc-wdm0` which means that the driver is installed.

For unknown reason, UC20 seems not work in this mode.

## 5.1. Settings

For QMI mode, you need to change the network settings to dhcp and set the ifname to wwan0.

```
config interface 'wwan'
    option proto 'dhcp'
    option ifname 'wwan0'
```

You need to do a network restart

```
/etc/init.d/network restart
```

## 5.2. Tools

### Check connection status

```
root@OpenWrt:~# uqmi -d /dev/cdc-wdm0 --get-data-status
"disconnected"
```

### Get signal info

```
root@OpenWrt:~# uqmi -d /dev/cdc-wdm0 --get-signal-info
{
  "type": "lte",
  "rssi": -71,
  "rsrq": -9,
  "rsrp": -94,
  "snr": 70
}
```

To start the Internet connection, replace “apn” with your real apn

```
uqmi -d /dev/cdc-wdm0 --start-network apn --autoconnect
```

Then you will see you have wwan0 in your ifconfig

```
root@domino:~# ifconfig wwan0
wwan0  Link encap:Ethernet HWaddr 9A:02:75:A0:CA:59
        inet6 addr: fe80::9802:75ff:fea0:ca59/64 Scope:Link
        UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
        RX packets:0 errors:0 dropped:0 overruns:0 frame:0
        TX packets:254 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:0 (0.0 B) TX bytes:82077 (80.1 KiB)
```

## 5.3. AT commands

You can also use low level AT commands to start the Internet.

The apn, username and password should be sent in the following format:

```
AT+QICSGP=1,1,"apn" [,"username","password" [<authentication>]]]
```

For example, my apn is "pccw", I am using the following command.

```
cat /dev/ttyUSB2 &
echo -en "AT+QICSGP=1,1,\"pccw\", \"\", \"\", \"\", 0\r\n" > /dev/ttyUSB2
echo -en "AT+QCFG=\"rmnet/autoconnect\",1,0\r\n" > /dev/ttyUSB2
```

You need to do a RESET to make the changes take effect according to Quectel manual.

```
echo -e "AT+QRST=1,0\r\n" > /dev/ttyUSB2
```

## 6. GPS Location

This only applies to Quectel UC20 3g module, which has GPS built in.

### Initialization Command:

```
echo -e "AT+QGPSCFG=\"outport\", \"usbnmea\" \r\n" > /dev/ttyUSB2
echo -e "AT+QGPSCFG=\"nmeasrc\",1 \r\n" > /dev/ttyUSB2
echo -e "AT+QGPSCFG=\"gpsnmeatype\",1 \r\n" > /dev/ttyUSB2
echo -e "AT+QGPSCFG=\"glonassnmeatype\",4 \r\n" > /dev/ttyUSB2
echo -e "AT+QGPSCFG=\"glonassenable\",0 \r\n" > /dev/ttyUSB2
echo -e "AT+QGPSCFG=\"odpcontrol\",0 \r\n" > /dev/ttyUSB2
echo -e "AT+QGPSCFG=\"dpoenable\",0 \r\n" > /dev/ttyUSB2
echo -e "AT+QGPS=1 \r\n" > /dev/ttyUSB2
```

### Location Command:

```
echo -e "AT+QGPSLOC? \r\n" > /dev/ttyUSB2
cat /dev/ttyUSB2
```

### Module Closure:

```
echo -e "AT+QGPSEND \r\n" > /dev/ttyUSB2
```

## 7. Install packages and Compile firmware

### 7.1. Install packages

You can install applications to your board from openwrt repo.

```
opkg update
opkg install [package name]
```

The current firmware is still an engineering firmware so you may not install kernel modules directly in this way. You can compile your own firmware.

### 7.2. Compile your firmware (Ubuntu)

We strongly suggest you get a Linux machine for development with the MiFi board. However, using Linux in virtual machine is fine. The following guide is for Ubuntu.

## Install some software

```
#sudo apt-get update
# sudo apt-get install subversion build-essential git-core libncurses5-dev zlib1g-dev gawk flex quilt libssl-dev
xsltproc libxml-parser-perl mercurial bzip2 ecj cvs unzip
```

## Get openwrt source

```
git clone https://github.com/domino-team/openwrt-cc.git openwrt-mifi
```

## Update and install feeds

```
cd openwrt-mifi
./scripts/feeds update -a
./scripts/feeds install -a
```

## Copy files

We need to copy some files to OpenWrt tree, including default configurations (“files”), software packages (“dl”) and Domino WebUI (“domino”).

```
cp files to openwrt-mifi/ -r
cp dl to openwrt-mifi/ -r
```

```
cp domino to openwrt-mifi/package/ -r
```

## Menuconfig and compile firmware

Type “make menuconfig” and choose the packages that you want to compile. Here you need to choose the Target profile as “GL-Domino” and then choose “domino-mifi” package. All the dependent packages will be selected automatically.

```
make menuconfig
  Target profile(Domino Wifi for things) --->
  domino --->
    <*>domino-mifi
make V=s -j5
```

By adding “-j5” we use multi-thread to compile the firmware. If you have errors, just remove this parameter.

```
make
```

Finally, you can get what you want firmware at [openwrt-mifi/bin/ar71xx/],firmware’s name is [openwrt-ar71xx-generic-domino-squashfs-sysupgrade.bin]

# 8. Troubleshooting

## No ttyUSB0~ttyUSB4

This generally means the driver is not installed or the module is not recognized. You may need to check the connections of the module

### Field: [option\_instat\_callback: error -2] appears after startup

For some complicated reasons:

- (1) Bad contact of SIM Card.
- (2) No antenna inserted.
- (3) Wrong operator parameters.
- (4) No network.
- (5) Data interface (ttyUSBx) configured incorrectly.

When this happens:

- Check connection
- Connect antennas
- Correct network settings
- After you have done the above, try to restart network by execute `/etc/init.d/network restart` . If the error still exists, try to unplug the power and plug the power again. Simply reboot the device without unplug the device may not help.