1. Hardware

	**Hardware System**	MIPS MTK7628 580MHz 16MB Flash 64MB DDR2 RAM 16GB Storage *Note:RAM 128MB, Flash 32MB optional*
	Interface	2x SIM Slot 2x 10/100M Ethernet Port 1x RS232(Rx, Tx and GND) 1x RS485 3x IO 1x DC(2 Pins plugs) 2x SMA-K 5G Antennas 2x SMA-RP Wi-Fi Antennas 1x Reset

1) Ethernet Ports

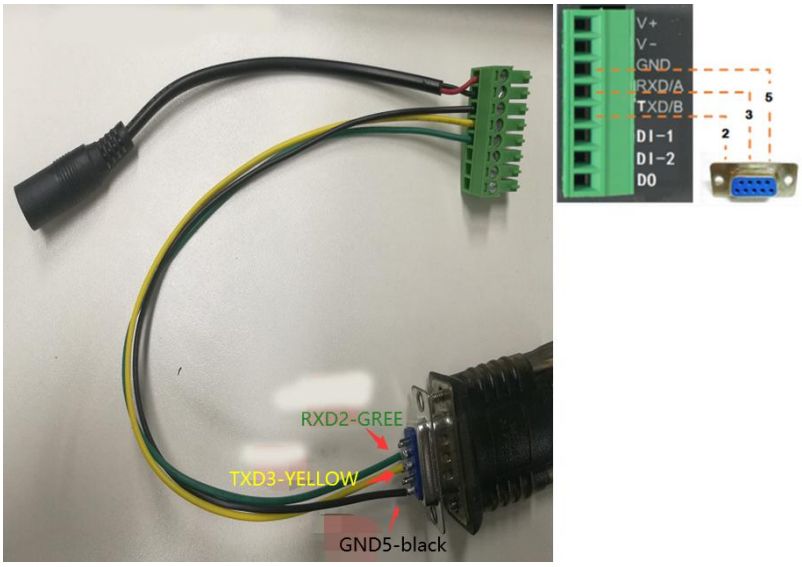
1x WAN/LAN(LAN1), 1x LAN2

- both Ethernet ports can be configured in VLAN in the GUI, refer to the product manual for details

2) Serial Ports

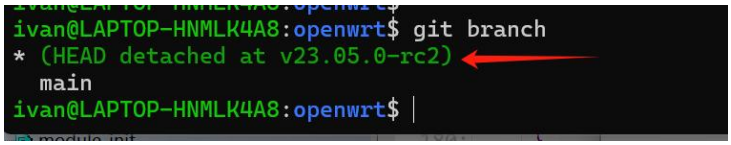
1x RS232(pin terminal), 1x RS232 (Console)

- the new model has the RX&RX wire line sequence reversed from the old one, only the serial port on the terminal block is used for printing device information



2. Download OpenWRT source codes

1)git clone https://github.com/openwrt/openwrt.git
2)cd openwrt;git checkout v23.05.0-rc2
3)git bracn -a



3. feeds.conf.default to add modem management tool

src-git mobile_broadband https://gitlab.freedesktop.org/mobile-broadband/mobile-broadband-openwrt.git
src-git luci_proto_modemmanager https://github.com/nickberry17/luci-proto-modemmanager.git

Note: Version 23.05 or above, support ModemManager dial-up tool, no need to feed download

4. make menuconfig to choose MT7628 EVB version

1)Target System (MediaTek Ralink MIPS) --->
2)Subtarget (MT76x8 based boards) --->
3)Target Profile (MediaTek MT7628 EVB) --->
4) Default Factory Evaluation/Reference Board EVB Firmware Configuration File for R220


Rx-MT7628.config

5. make menuconfig to choose modem management tool and qmi/mbim driver

1)LUCI
Protocols --->
- <*> luci-proto-modemmanager. Support for ModemManager
- <*> luci-proto-qmi. Support for QMI

2) Network --->
WWAN --->
- <*> comgt. Option/Vodafone 3G/GPRS control tool
- <*> umbim. Control utility for mobile broadband modems
- <*> uqmi. Control utility for mobile broadband modems

-*- modemmanager..... Control utility for any kind of mobile broadband modem
3)

- <*> Kernel modules > USB Support > <*> kmod-usb-serial-pl2303.
- <*> Detran custom > <*> pl2303gpio.

6. Kernel Custom

6.1 Modify firmware volume and partition size

1) <openwrt>/target/linux/ramips/image/mt76x8.mk

```
382
383  define Device/mediatek_mt7628an-eval-board
384    IMAGE_SIZE := 16064k
385    DEVICE_VENDOR := MediaTek
386    DEVICE_MODEL := MT7628 EVB
387    DEVICE_PACKAGES := kmod-usb2 kmod-usb-ohci kmod-usb-ledtrig-usbport
388    SUPPORTED_DEVICES += mt7628
389  endef
390  TARGET_DEVICES += mediatek_mt7628an-eval-board
391
```

<openwrt>/target/linux/ramips/dts/mt7628an_mediatek_mt7628an-eval-board.dts

Note: The following example is a device tree configuration with 64MB DDR2 and 16MB flash

```
#include "mt7628an.dtsi"

#include <dt-bindings/gpio/gpio.h>
#include <dt-bindings/input/input.h>
/ {
    compatible = "mediatek,mt7628an-eval-board", "mediatek,mt7628an-soc";
    model = "Mediatek MT7628AN evaluation board";

    chosen {
        bootargs = "console=ttyS0,115200";
    };
        memory@0 {
                device_type = "memory";
                reg = <0x0 0x4000000>;
        };
    keys {
```

```
&spi0 {
    status = "okay";

    flash@0 {
        compatible = "jedec,spi-nor";
        reg = <0>;
        spi-max-frequency = <10000000>;

        partitions {
            compatible = "fixed-partitions";
            #address-cells = <1>;
            #size-cells = <1>;

            partition@0 {
                label = "u-boot";
                reg = <0x0 0x30000>;
                read-only;
            };

            partition@30000 {
                label = "u-boot-env";
                reg = <0x30000 0x10000>;
                read-only;
            };

            factory: partition@40000 {
                label = "factory";
                reg = <0x40000 0x10000>;
                read-only;
            };

            partition@50000 {
                compatible = "denx,uimage";
                label = "firmware";
                reg = <0x50000 0x1fb0000>;
            };
        };
    };
};
```

6.2 Modify the baud rate of the debugging serial port

<openwrt>/target/linux/ramips/dts/mt7628an_mediatek_mt7628an-eval-board.dts

```
#include "mt7628an.dtsi"

#include <dt-bindings/gpio/gpio.h>
#include <dt-bindings/input/input.h>
/ {
    compatible = "mediatek,mt7628an-eval-board", "mediatek,mt7628an-soc";
    model = "Mediatek MT7628AN evaluation board";

    chosen {
        bootargs = "console=ttyS0,115200";
    };
        memory@0 {
                device_type = "memory";
                reg = <0x0 0x4000000>;
        };
```

6.3 Add GPIO control, including module power-up, RST recovery button, LED light control, IO control and other definitions.

<openwrt>/target/linux/ramips/dts/mt7628an_mediatek_mt7628an-eval-board.dts

```
leds {
    compatible = "gpio-leds";

    signal1 {
        label = "green:signal1";
        gpios = <&gpio 4 GPIO_ACTIVE_HIGH>;
    };

    signal2 {
        label = "green:signal2";
        gpios = <&gpio 5 GPIO_ACTIVE_HIGH>;
    };

    signal3 {
        label = "green:signal3";
        gpios = <&gpio 45 GPIO_ACTIVE_HIGH>;
    };

    err {
        label = "green:err";
        gpios = <&gpio 46 GPIO_ACTIVE_LOW>;

    };

    wlan {
        label = "green:wlan";
        gpios = <&gpio 12 GPIO_ACTIVE_LOW>;
    };
};
```

```
gpio_export {
    compatible = "gpio-export";
    #size-cells = <0>;
    modem {
        gpio-export,name = "modem";
        gpio-export,output = <1>;
        gpios = <&gpio 2 GPIO_ACTIVE_LOW>;
    };

    sim {
        gpio-export,name = "sim";
        gpio-export,output = <0>;
        gpios = <&gpio 3 GPIO_ACTIVE_LOW>;
    };

    usb0 {
        gpio-export,name = "usb0";
        gpio-export,output = <1>; // GPIOF_OUT_INIT_HIGH
        gpios = <&gpio 2 GPIO_ACTIVE_HIGH>;
    };
};
```

6.4 MT7628 native GPIO definition for watchdog and reset

<openwrt>/target/linux/ramips/dts/mt7628an_mediatek_mt7628an-eval-board.dts

```
watchdog {
        compatible = "linux,wdt-gpio";
        gpios = <&gpio 11 GPIO_ACTIVE_LOW>;
        hw_algo = "toggle";
        hw_margin_ms = <2000>;
        always-running;
};
```

```
#include <dt-bindings/input/input.h>
/ {
    compatible = "mediatek,mt7628an-eval-board", "mediatek,mt762
    model = "Mediatek MT7628AN evaluation board";

    chosen {
        bootargs = "console=ttyS0,115200";
    };
        memory@0 {
                device_type = "memory";
                reg = <0x0 0x4000000>;
        };
    keys {
        compatible = "gpio-keys";

        reset {
            label = "reset";
            gpios = <&gpio 38 GPIO_ACTIVE_LOW>;
            linux,code = <KEY_RESTART>;
        };


    };
```

6.5 Watchdog kernel configuration

<openwrt>/target/linux/ramips/mt76x8/config-5.15

```
CONFIG_SRCU=y
CONFIG_SWCONFIG=y
CONFIG_SWCONFIG_LEDS=y
CONFIG_SWPHY=y
CONFIG_SYSCTL_EXCEPTION_TRACE=y
CONFIG_SYS_HAS_CPU_MIPS32_R1=y
CONFIG_SYS_HAS_CPU_MIPS32_R2=y
CONFIG_SYS_HAS_EARLY_PRINTK=y
CONFIG_SYS_SUPPORTS_32BIT_KERNEL=y
CONFIG_SYS_SUPPORTS_ARBIT_HZ=y
CONFIG_SYS_SUPPORTS_LITTLE_ENDIAN=y
CONFIG_SYS_SUPPORTS_MIPS16=y
CONFIG_SYS_SUPPORTS_ZBOOT=y
CONFIG_TARGET_ISA_REV=2
CONFIG_TICK_CPU_ACCOUNTING=y
CONFIG_TIMER_OF=y
CONFIG_TIMER_PROBE=y
CONFIG_TINY_SRCU=y
CONFIG_USB_SUPPORT=y
CONFIG_USE_OF=y
CONFIG_WATCHDOG_CORE=y
CONFIG_GPIO_WATCHDOG=y
# CONFIG_GPIO_WATCHDOG_ARCH_INITCALL is not set
```

6.6 Device tree, kernel configuration reference file

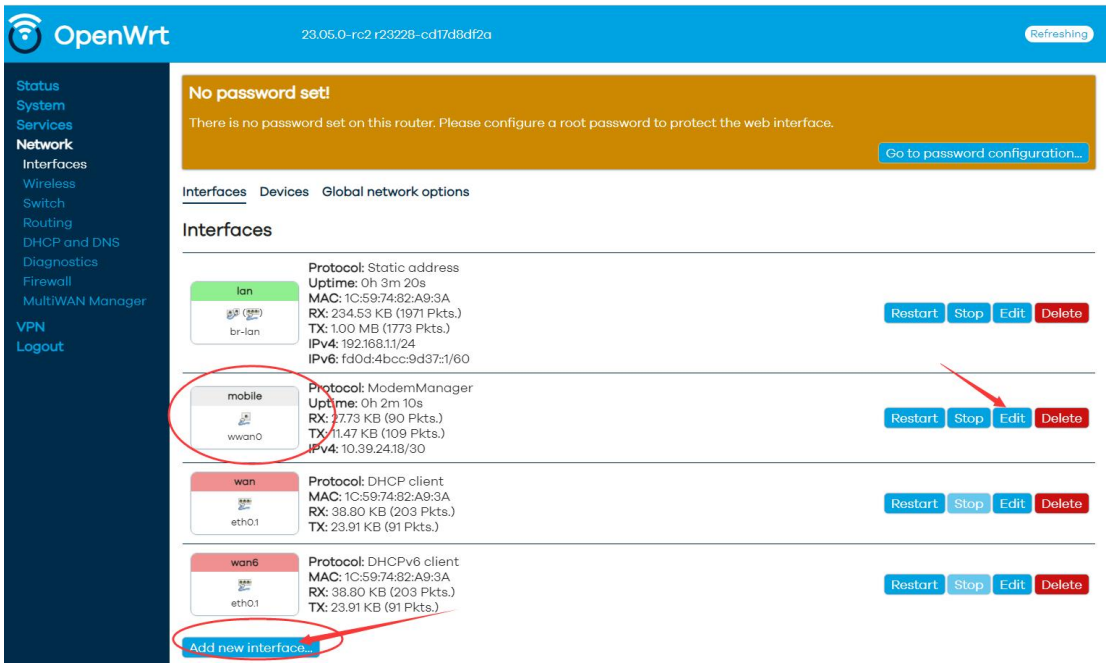

mt7628an_mediatek_mt7628an-e

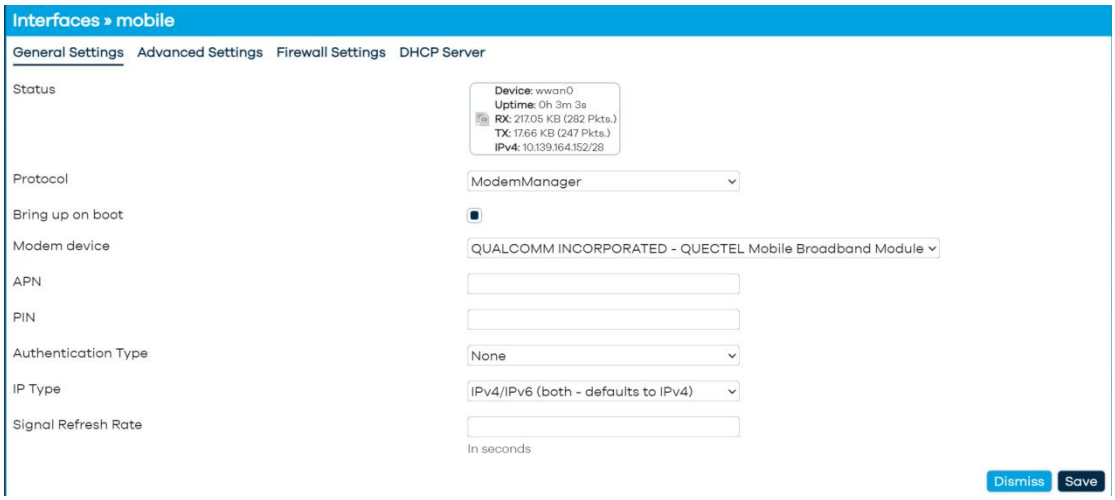

mt7628an.dtsi

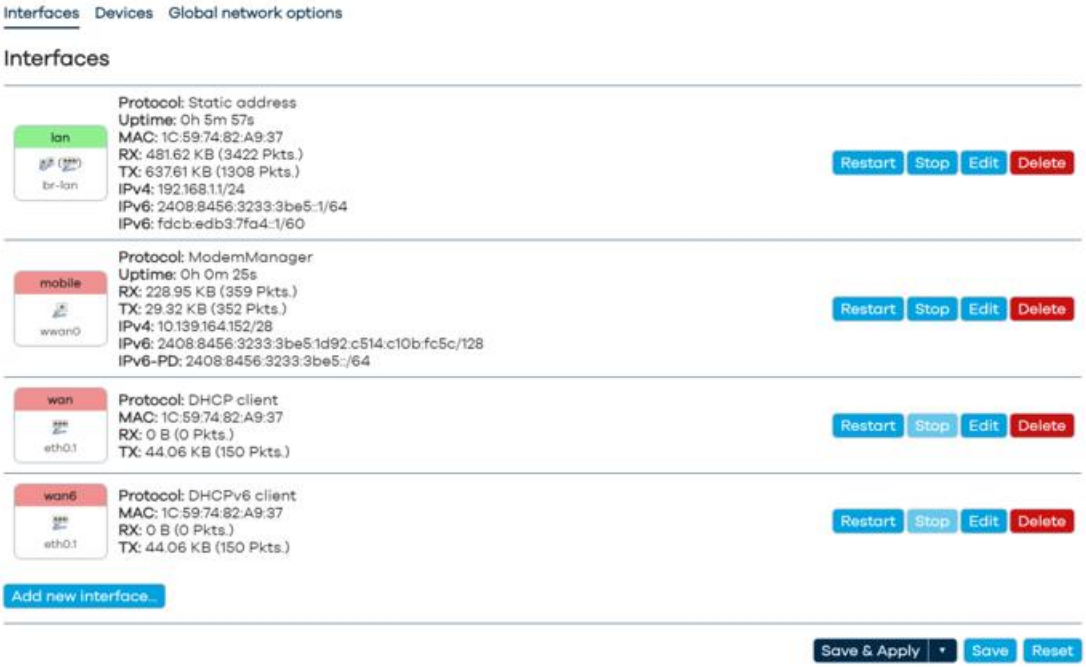

config-5.15

7. Enable 4G Modem

7.1 ModemManager






Interfaces
Devices
Global network options
Interfaces
lan
br-lan
Protocol: Static address
Uptime: 0h 5m 57s
MAC: 1C:59:74:82:A9:37
RX: 481.62 KB (3422 Pkts.)
TX: 637.61 KB (1308 Pkts.)
IPv4: 192.168.1.1/24
IPv6: 2408:8456:3233:3be5::1/64
IPv6: fdcb:edb3:7fa4::1/60
Restart
Stop
Edit
Delete
mobile
wwan0
Protocol: ModemManager
Uptime: 0h 0m 25s
RX: 228.95 KB (359 Pkts.)
TX: 29.32 KB (352 Pkts.)
IPv4: 10.139.164.152/28
IPv6: 2408:8456:3233:3be5:1d92:c514:c10b:fc5c/128
IPv6-PD: 2408:8456:3233:3be5::/64
Restart
Stop
Edit
Delete
wan
eth0.1
Protocol: DHCP client
MAC: 1C:59:74:82:A9:37
RX: 0 B (0 Pkts.)
TX: 44.06 KB (150 Pkts.)
Restart
Stop
Edit
Delete
wan6
eth0.1
Protocol: DHCPv6 client
MAC: 1C:59:74:82:A9:37
RX: 0 B (0 Pkts.)
TX: 44.06 KB (150 Pkts.)
Restart
Stop
Edit
Delete
Add new interface...
Save & Apply
Save
Reset

Mobile Service

/sys/devices/platform/101c0000.ehci/usb1/1-1/1-1.1

Modem Info

Manufacturer	QUALCOMM INCORPORATED
Model	QUECTEL Mobile Broadband Module
Revision	EG95AUXGAR08A04M1G
IMEI	86844405[redacted]
Device Identifier	f7599b39b5d3873b74f598de1e2a53ea52df2bc3
Power State	on
State	connected

Network Registration

Own Numbers	86186[redacted]
Access Technologies	lte
Operator	CHN-UNICOM
Operator Code	46001
Registration State	home
Packet Service State	attached
Signal Quality	100 %

Cell Location

CID	0D0E1800
LAC	0000
MCC	460
MNC	01
TAC	00770E

SIMs

SIM 1

Active	yes
Operator Name	UNICOM
ICCID	8986012080[redacted]
IMSI	460010352[redacted]

8. GPIO control and testing

8.1 Extract the R220 GPIO control package to the <openwrt>/package directory:

pl2303gpio.tar.gz

8.2 GPIO instruction

GPIO List		
GPIO45 ND-D0	Signal_1 Net1_Green	Signal LED1, light at high level
GPIO5 ND-D1	Signal_2 Net1_Green	Signal LED2, light at high level
GPIO4 ND-D2	Signal_3 Net2_Green	Signal LED3, light at high level

GPIO46 ND-D3	Error Net2_Green	Error LED. light at low level No 5G module or network for Red
GPIO2	Module_PWR	4G Module power control High level for power on Low level for power off
GPIO3 JTRST	SIM_Choose	Control SIM card High level for SIM2 Low level for SIM1 Power OFF 4G module at first, then control GPIO to switch SIM card. Then power on 4G module in 8sec.
GPIO38	Default Factory	
GPIO44	WLAN	

GPIO2

GPIO2 for 4G module power control

- cd /sys/class/gpio/usb0 （GPIO2 is exported from dts file）
- echo 1 > value （Power on）
- echo 0 > value （Power off）

GPIO 3

GPIO3 for SIM choose

- cd /sys/class/gpio/sim （GPIO3 is exported from dts file）
- echo 1 > value (High level for SIM2)
- echo 0 > value (Low level for SIM1)

Power OFF 4G module at first, then control GPIO to switch SIM card. Then power on 4G module in 8sec.

LED Control

- cd /sys/class/gpio
- echo N > export (N for GPIO value. Signal LED indicators for 4,5,45. Error LED indicator for 46. WLAN LED indicator for 44)
- echo out > gpioN/direction (N for GPIO value. Signal LED indicators for 4,5,45. Error LED indicator for 46. WLAN LED indicator for 44. Direction for output)
- echo 1 > gpioN/value (N for GPIO value. Signal LED indicators for 4,5,45. Error LED indicator for 46. WLAN LED indicator for 44. value 1 for WLAN LED Light on)
- echo 0 > gpioN/value (N for GPIO value. Signal LED indicators for 4,5,45. Error LED indicator for 46. WLAN LED indicator for 44. value 0 for WLAN LED Light off)

Extend GPIO to Control DI/DO

- cd /sys/class/gpio (PL2303 driver file patch exports gpiochip508)
- echo 508 > export (508 for DI 1. gpio508/value for input signal. 1 for low level. 0 for high level)
- echo 509 > export (509 for DI 2. gpio509/value for input signal. 1 for low level. 0 for high level)
- echo 510 > export (510 for DO. gpio510/value for output signal. 1 for low level. 0 for high level)

9. Storage

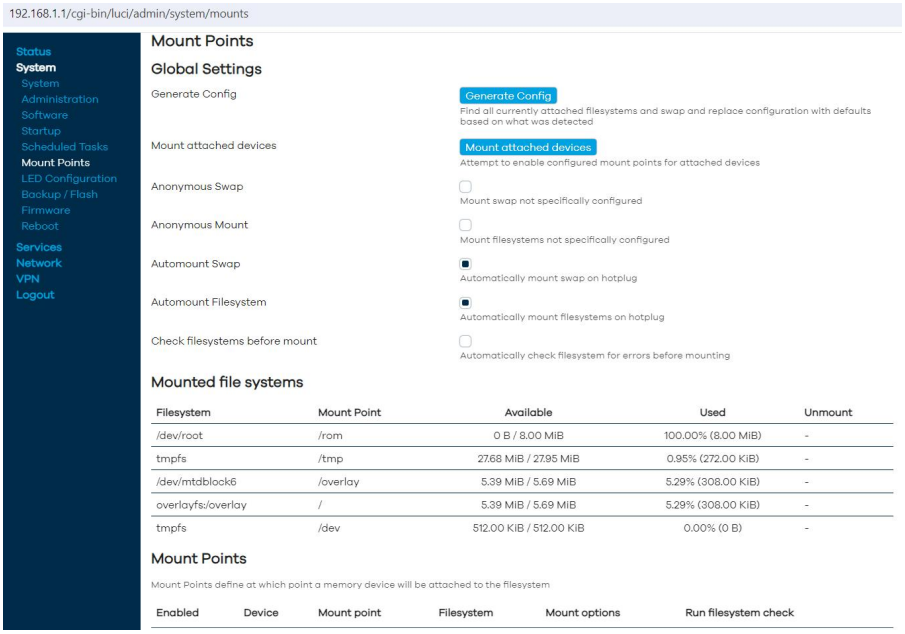
9.1 Load Driver

- -*- kmod-usb-storage..... USB Storage support
- <*> kmod-usb-storage-extras..... Extra drivers for usb-storage
- -*- kmod-scsi-core..... SCSI device support
- <*> kmod-fs-ext4..... EXT4 filesystem support
- <*> kmod-fs-ntfs..... NTFS filesystem support
- <*> kmod-fs-vfat..... VFAT filesystem support

```
[    6.902845] usb-storage 1-1.3:1.0: USB Mass Storage device detected
[    6.910234] scsi host0: usb-storage 1-1.3:1.0
[    7.949421] scsi 0:0:0:0: Direct-Access     Kingston DataTraveler 2.0 1.00 PQ: 0 ANSI: 4
[    7.963374] sd 0:0:0:0: [sda] 15131636 512-byte logical blocks: (7.75 GB/7.21 GiB)
[    7.972245] sd 0:0:0:0: [sda] Write Protect is off
[    7.977120] sd 0:0:0:0: [sda] Mode Sense: 45 00 00 00
[    7.977914] sd 0:0:0:0: [sda] Write cache: disabled, read cache: enabled, doesn't support DPO or FUA
[    7.996408] sd 0:0:0:0: [sda] Attached SCSI removable disk
```

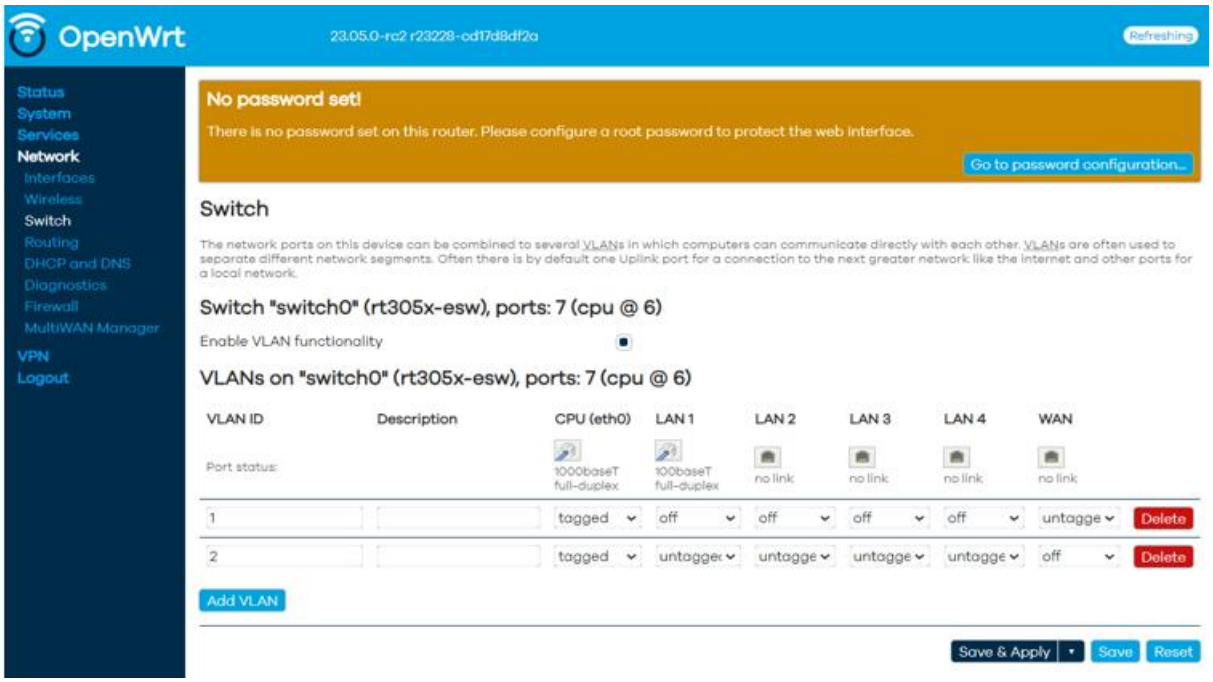
9.2 mount -t vfat /dev/sda/mnt

9.3 Configure the auto loading



10. VLAN Configuration

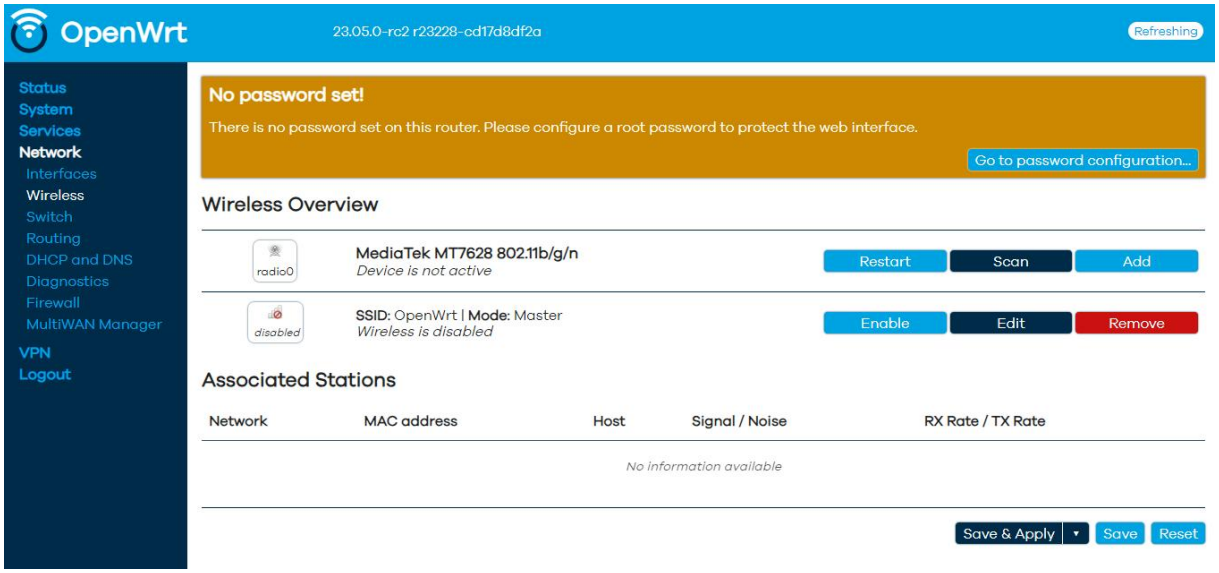
10.1 1x WAN(LAN1) and 1x LAN (LAN2) port as default



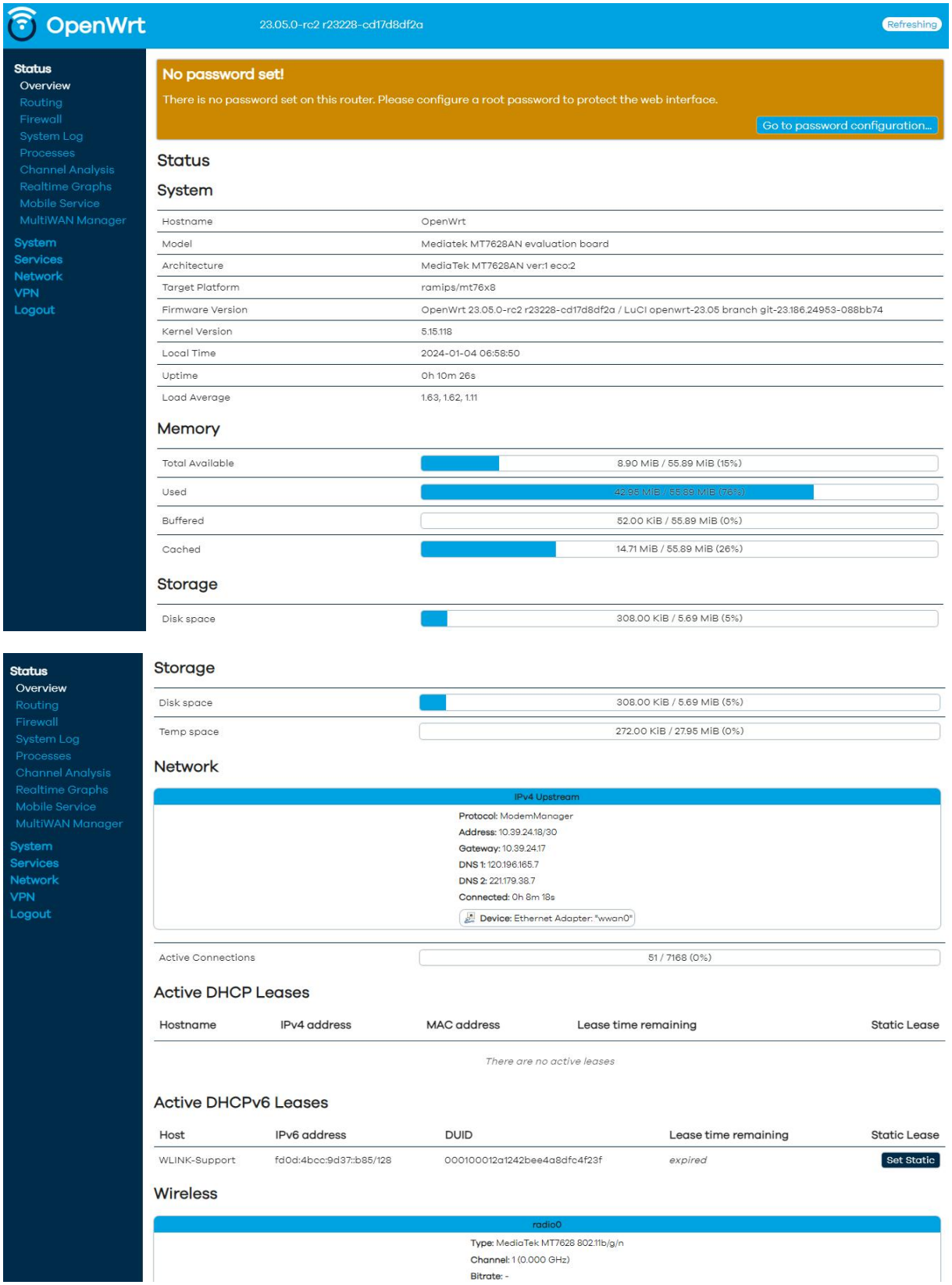
10.2 If configure 2 x LAN, we can /etc/config/network file, refer to the following configuration:

network

11. Enable Wi-Fi

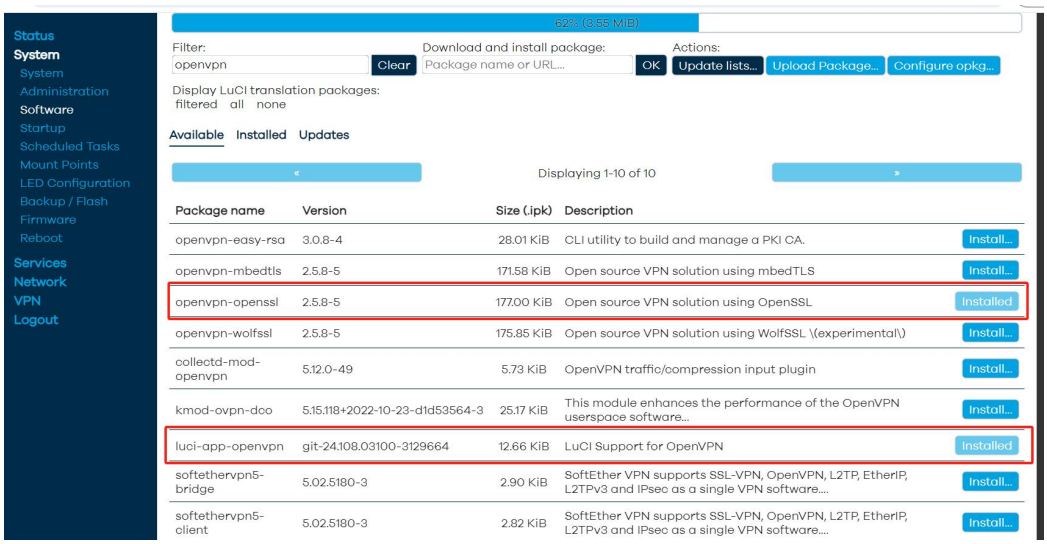


12. Status GUI



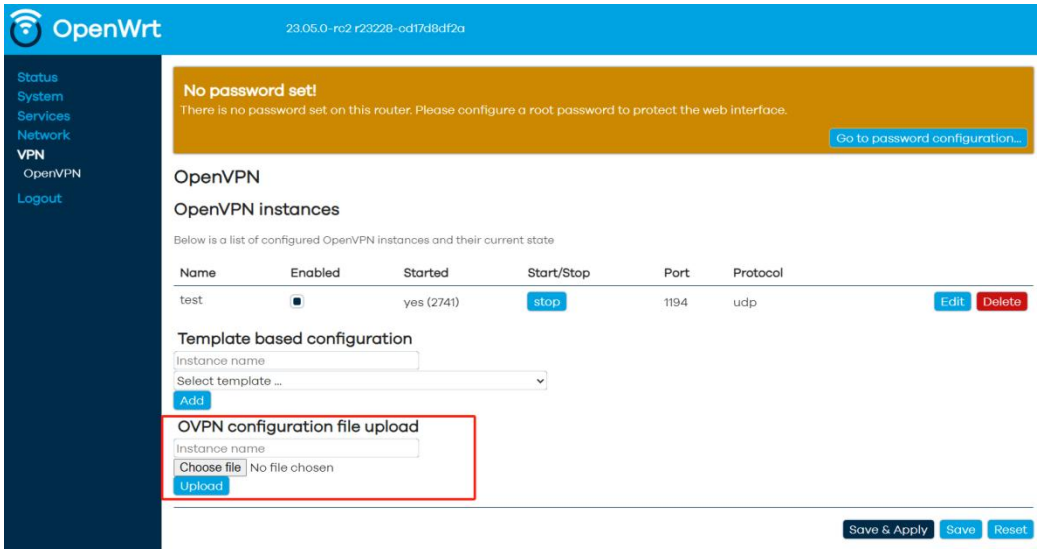
13. OpenVPN

13.1 Installing OpenVPN-openssl and luci-app-openvpn



13.2 Upload client.ovpn file

Note: please test in advance that this client.ovnp file also works on windows.



Check the status in the system log