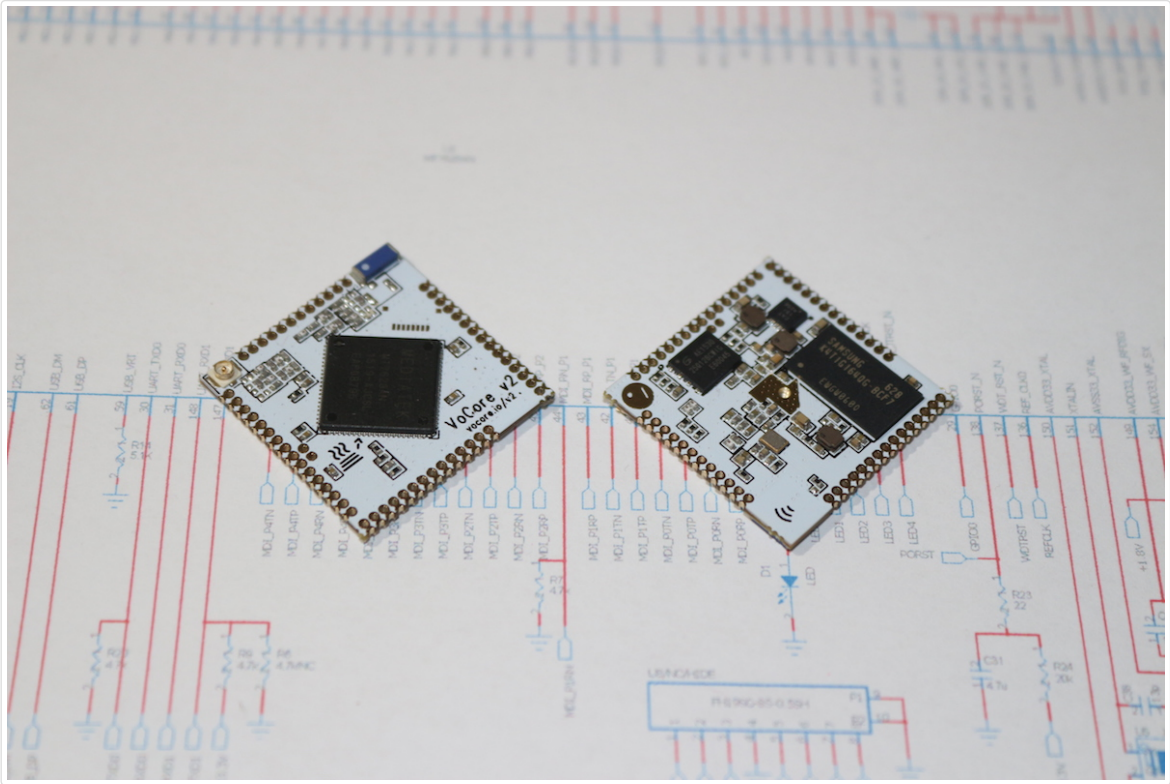
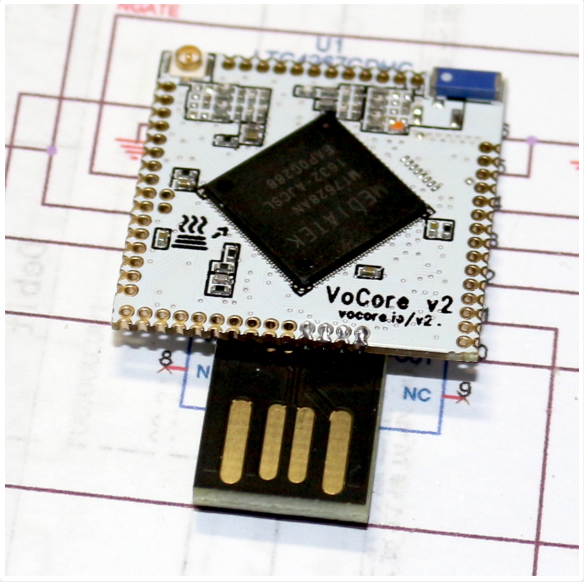
VoCore2

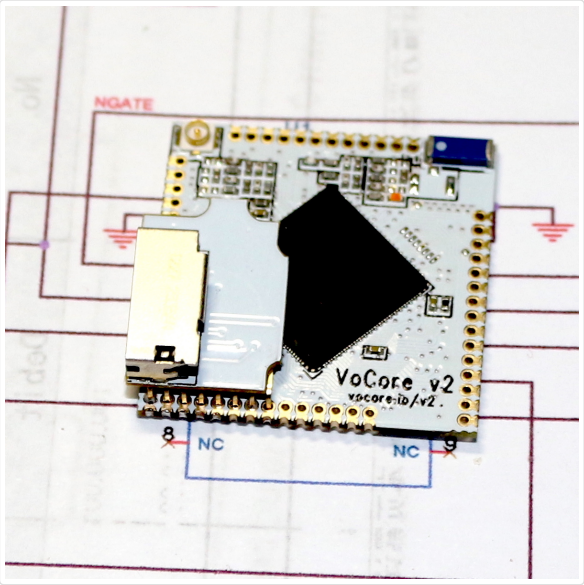
The Coin-sized Linux Computer



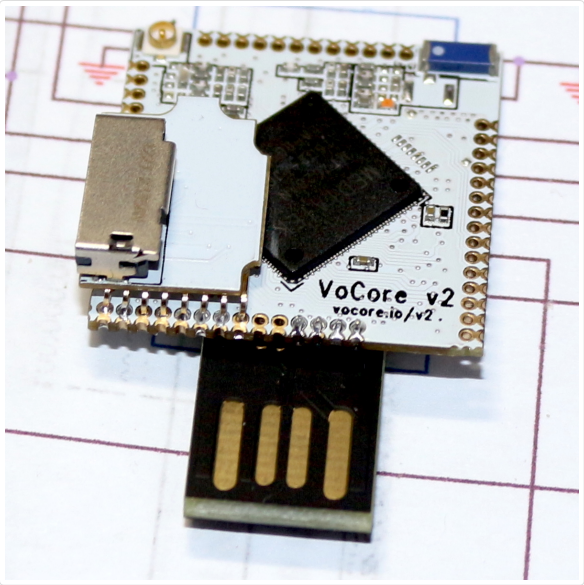
VoCore2 + USB Header (Power Supply Only)



VoCore2 + MicroSD



VoCore2 + USB Header + MicroSD



note: DDR2 is ESD sencitive, better to use hot air solder without touch

Parameters

	Details
SIZE	25.6mm x 25.6mm x 3.0mm
CPU	MT7628AN, 580 MHz, MIPS 24K
MEMORY	128MB, DDR2, 166MHz
STORAGE	16M NOR on board, support SDXC up to 2TB
WIRELESS	802.11n, 2T2R, speed up to 300Mbps.
ANTENNA	One U.FL slot, one on board antenna.
ETHERNET	1 port/5 ports, up to 100Mbps.
USB	Support USB 2.0, up to 480MBit/s.
GPIO	around 40 (pinmux)
UART	x3 (UART2 for debug console)
PWM	x4
TEMPERATURE	0 ~ 40C, indoor only

	Details
POWER SUPPLY	3.6V ~ 6.0V, 500mA
POWER CONSUMPTION	74mA wifi standby, 230mA wifi full speed, 5V input.

Sources

Hardware: Download (http://vonger.cn/misc/vocore2/source.zip) `md5:710ce05e5f95076b5e42b2feaf8a4de4`

OpenWrt 1505: Download (http://vonger.cn/misc/vocore2/openwrt.tar.bz2) `md5:613621b833102e7ccde7b50c5f5ef6a7`

MediaTek SDK: Download (http://vonger.cn/misc/vocore2/mtksdk-openwrt-3.10.14-20141127-30965ec3.tar.bz2) `md5:4591c418ba6599920337859633d2aa18`

UBoot: Download (Github) (https://github.com/Vonger/Das-U-boot)

WiFi Driver: Download (Github) (https://github.com/Vonger/vocore2) `support latest openwrt`

Downloads

note: normally, we upgrade or fix brick are using Firmware. Flash Image is a clone of the full flash, for professional usage only.

Firmware(128MB): Download (http://vonger.cn/misc/vocore2/20170527V.bin) `md5:6f7c4b019577a7cec077562b75bc838b`

Firmware(64MB, for Lite): Download (http://vonger.cn/misc/vocore2/20170211L.bin) `md5:2162ef05b5232154d4f20dee57561da7`

Flash Image: Download (http://vonger.cn/misc/vocore2/ultimate.16m.img) `md5:f4c527a1e563d0ad7ef9ab0b5e0b35c6`

Toolchain: Download (Ubuntu 14.04 x64) (http://vonger.cn/misc/vocore2/toolchain.tar.bz2)

UBoot: Download (http://vonger.cn/misc/vocore2/uboot.20180427.bin) `md5:47166dd2acae029b072ad7fe735c7bc9`

Datasheet: Download (http://vonger.cn/misc/vocore2/datasheet.zip)

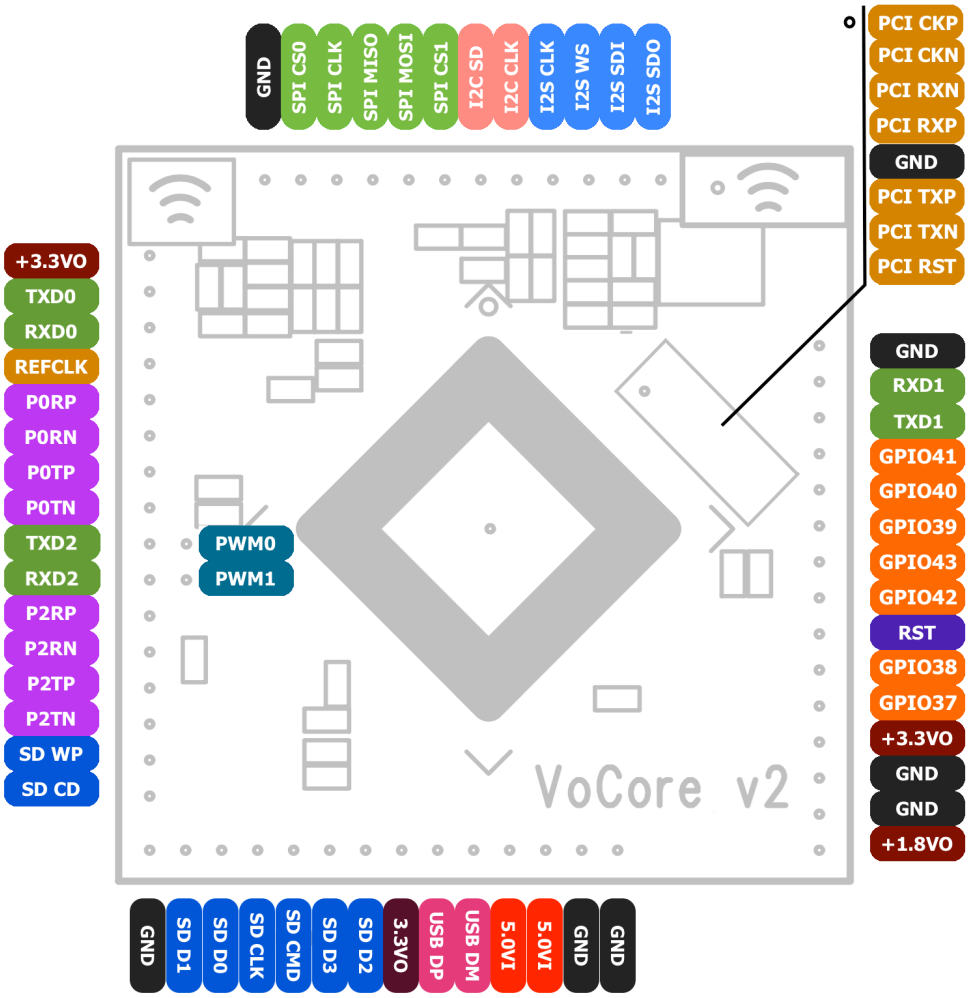
Links

VoCore2 + Dock (v2u.html) Ultimate version makes it easy to use.

VoCore Camera (camera.html) Tiny camera supports h264 + microphone.

Details

VoCore2 is a successor of VoCore, make it more fast, stable, but still same size.



`pin id is same as the one on MT76x8 datasheet in source`

Left	Name	Mux	Note
-	+3.3VO	+3.3V output	max output current 100mA
30	TXD0	GPIO12, UART0 Lite TXD	3.3V
31	RXD0	GPIO13, UART0 Lite RXD	3.3V
29	REFCLK	GPIO11, reference clock, SDXC CLK*	
33	P0RP	10/100 PHY Port #0 RXP	
34	P0RN	10/100 PHY Port #0 RXN	
35	P0TP	10/100 PHY Port #0 TXP	
36	P0TN	10/100 PHY Port #0 TXN	
43	TXD2	10/100 PHY Port #1 TXN, GPIO15, PWM Channel, SPI Slave Clock	
44	RXD2	10/100 PHY Port #1 TXP, GPIO14, PWM Channel, SPI Slave Chip Select	
40	PWM0	10/100 PHY Port #1 RXN, GPIO17, UART2 Lite TXD, SPI Slave MOSI	4.7K pull down to GND
42	PWM1	10/100 PHY Port #1 RXP, GPIO16, UART2 Lite RXD, SPI Slave MISO	
45	P2RP	10/100 PHY Port #2 RXP, GPIO18, PWM Channel	
46	P2RN	10/100 PHY Port #2 RXN, GPIO19, PWM Channel	
47	P2TP	10/100 PHY Port #2 TXP, GPIO20, PWM Channel	
48	P2TN	10/100 PHY Port #2 TXN, GPIO21, PWM Channel	
49	SD WP	GPIO22, 10/100 PHY Port #3 TXP, SDXC WP	
50	SD CD	GPIO23, 10/100 PHY Port #3 TXN, SDXC CD	

Top	Name	Mux	Note
-	GND	Groud	
28	SPI CS0	GPIO10, SPI Master Chip Select 0	4.7K pull up to 3.3V
25	SPI CLK	GPIO7, SPI Master Clock	4.7K pull up to 3.3V
26	SPI MISO	GPIO9, SPI Master In Slave Out	
27	SPI MOSI	GPIO8, SPI Master Out Slave In	4.7K pull down to GND
24	SPI CS1	GPIO6, SPI Master Chip Select 1	4.7K pull down to GND
21	I2C SD	GPIO5, I2C Data, SDXC D2*	4.7K pull up to 3.3V
20	I2C CLK	GPIO4, I2C Clock, SDXC D3*	4.7K pull up to 3.3V
19	I2S CLK	GPIO3, I2S Bit Clock, SDXC CMD*	
18	I2S WS	GPIO2, I2S L/R Clock, SDXC D0*	
16	I2S SDI	GPIO0, I2S Data In, SDXC D1*	
17	I2S SDO	GPIO1, I2S Data Out	4.7K pull down to GND

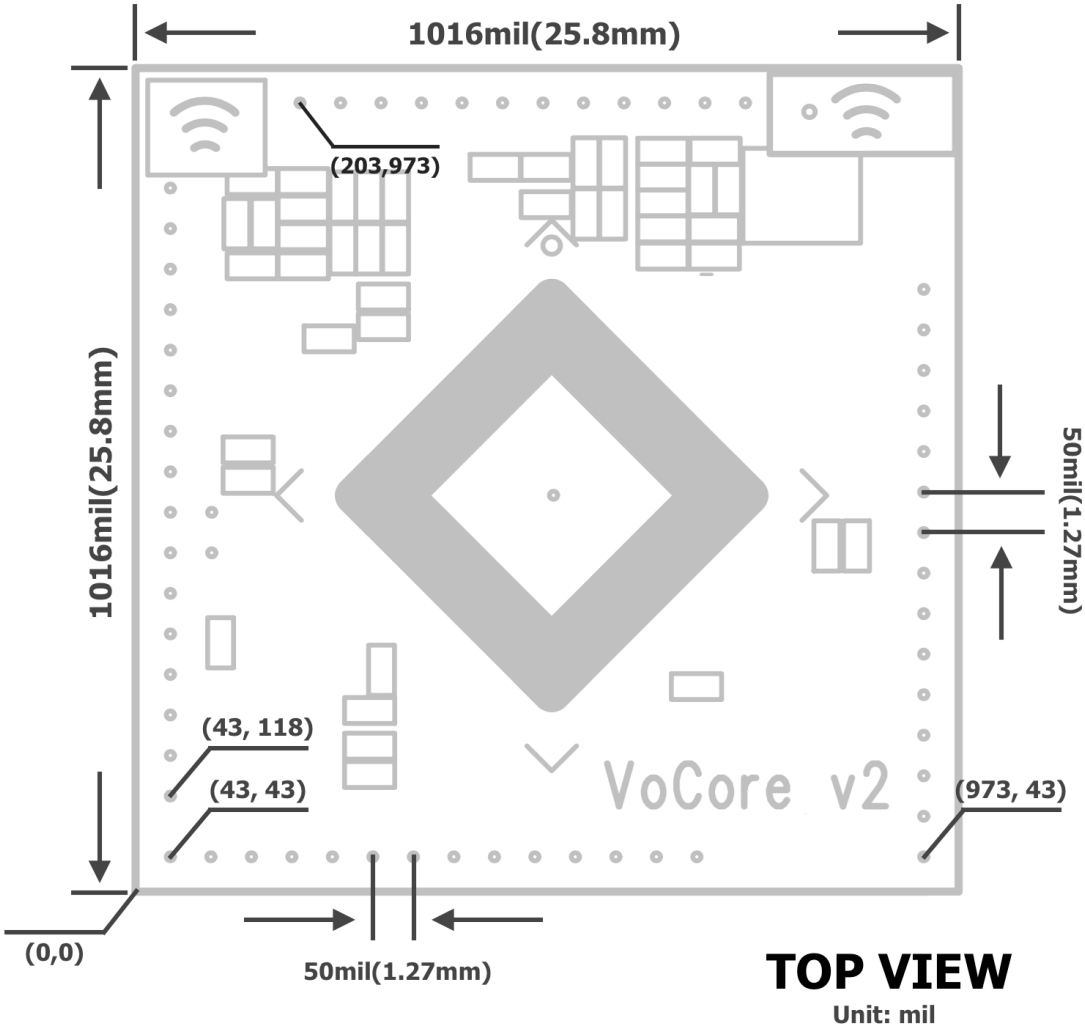
Right	Name	Mux	Note
-	GND	Ground	
148	RXD1	GPIO12, UART1 Lite RXD	3.3V
147	TXD1	GPIO13, UART1 Lite TXD	3.3V
141	GPIO41	GPIO41, JTAG TMS	JTAG needs 10K pull up, R9 -> R6
140	GPIO40	GPIO40, JTAG Clock	JTAG needs 10K pull up, R9 -> R6
139	GPIO39	GPIO39, JTAG Reset	JTAG needs 10K pull up, R9 -> R6
143	GPIO43	GPIO43, JTAG TDO	JTAG needs 10K pull up, R9 -> R6
142	GPIO42	GPIO42, JTAG TDI	JTAG needs 10K pull up, R9 -> R6

Right	Name	Mux	Note
138	RST	Reset, touch GND to reset	
137	GPIO38	GPIO38	
136	GPIO37	GPIO37	
-	+3.3VO	+3.3V output	max output current 100mA
-	GND	Ground	
-	GND	Ground	
-	+1.8VO	+1.8V output	max output current 100mA

Bottom	Name	Mux	Note
-	GND	Ground	
51	SD D1	GPIO24, 10/100 PHY Port #3 RXP, SDXC D1	
52	SD D0	GPIO25, 10/100 PHY Port #3 RXN, SDXC D0	
54	SD CLK	GPIO26, 10/100 PHY Port #4 RXP, SDXC CLK	
55	SD CMD	GPIO27, 10/100 PHY Port #4 RXN, SDXC CMD	
56	SD D3	GPIO28, 10/100 PHY Port #4 TXP, SDXC D3	
57	SD D2	GPIO29, 10/100 PHY Port #4 TXN, SDXC D2	
-	+3.3VO	+3.3V output	max output current 100mA
61	USB DP	USB2.0 Data+	
62	USB DM	USB2.0 Data-	
-	+5.0VI	+5.0V input	min input current 500mA
-	+5.0VI	+5.0V input	min input current 500mA
-	GND	Ground	
-	GND	Ground	

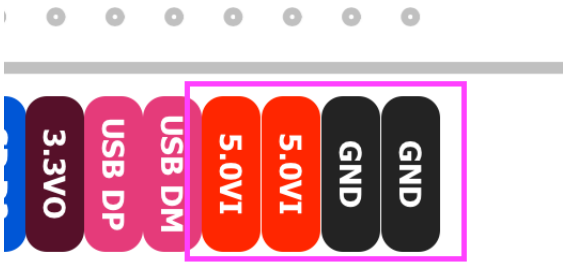
Middle	Name	Mux	Note
133	PCI CKP	PCI Express External Reference Clock Output+	
132	PCI CKN	PCI Express External Reference Clock Output-	
130	PCI RXN	PCI Express Differential Receiver RX-	
129	PCI RXP	PCI Express Differential Receiver RX+	
-	GND	Ground	
127	PCI TXP	PCI Express Differential Transmit TX+	
126	PCI TXN	PCI Express Differential Transmit TX-	
135	PCI RST	PCI Express Device Reset	

* five ethernet port mode, sdcard mux to i2s/i2c.



Tutorials

Connect to Power



1. connect to 3.6V~6.0V and GND with a stable power source, such as USB charger.

note: be careful, high voltage will damage your VoCore.

2. if everything works, after 30 seconds, you will find VoCore2 in your computer hotspot list.

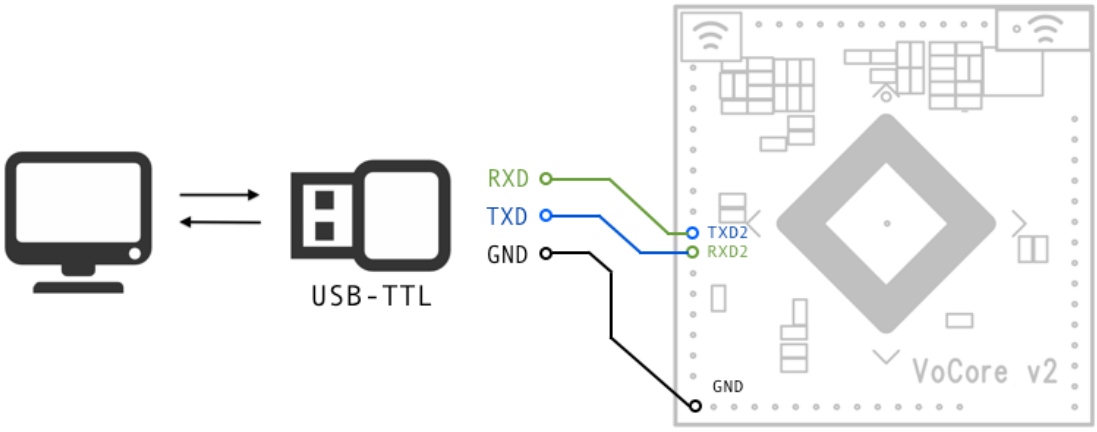
3. connect to VoCore2 hotspot.

4.a using ssh or putty or similar tools login to VoCore2(root/vocore).

4.b using USB2TTL, please check "Connect to VoCore through USB2TTL" section.

important : `UART speed is 115200bps, 8bits, no even, 1 stop bit`

Connect to VoCore through USB2TTL



video tutorial: youtube (https://youtu.be/W3UVXb5YM2k)

1. connect USB2TTL.TXD to VoCore2.RXD2, USB2TTL.RXD to VoCore2.TXD2, USB2TTL.GND to VoCore2.GND.

2. setup your serial application(such as putty for windows, kermit for mac,linux) in your computer to 115200bps, 8 data bits, no even, 1 stop bit.

3. power on your VoCore2, no you should find some text output.

Setup AP + STA Mode

video tutorial(require USB2TTL): youtube (https://youtu.be/IPt5cxg5K98)

1. connect to your VoCore through USB2TTL.

2. run command in console(UART console).

3. setup network to enable dhcp(get ip from your hotspot).

uci delete network.wwan

uci set network.wwan=interface

uci set network.wwan.proto=dhcp

uci commit

4. setup firewall to enable access to internet through your hotspot.

uci del_list firewall.@zone[1].network=wwan

uci add_list firewall.@zone[1].network=wwan

uci set firewall.@zone[1].input=ACCEPT

uci set firewall.@zone[1].output=ACCEPT

uci set firewall.@zone[1].forward=ACCEPT

uci set firewall.@zone[1].masq=1

uci set firewall.@zone[1].mtu_fix=1

uci commit

5. setup wireless to enable ap+sta mode.

uci set wireless.sta.ssid="[TARGET AP SSID]"

uci set wireless.sta.key="[TARGET AP PASSWORD]"

uci set wireless.sta.network=wwan

uci set wireless.sta.disabled=0

uci commit

note:replace [TARGET AP SSID] to the target ap ssid you want to connect to, [TARGET AP PASSWORD] is its password.

5. restart your network, it will work.

/etc/init.d/network restart

6.(option) once ap+sta is totally up, disable it in config, so if next time your target ap is missing, you still able to connect to VoCore2.

uci set wireless.sta.disabled=0

uci commit

/etc/init.d/network restart

sleep 10

uci set wireless.sta.disabled=1

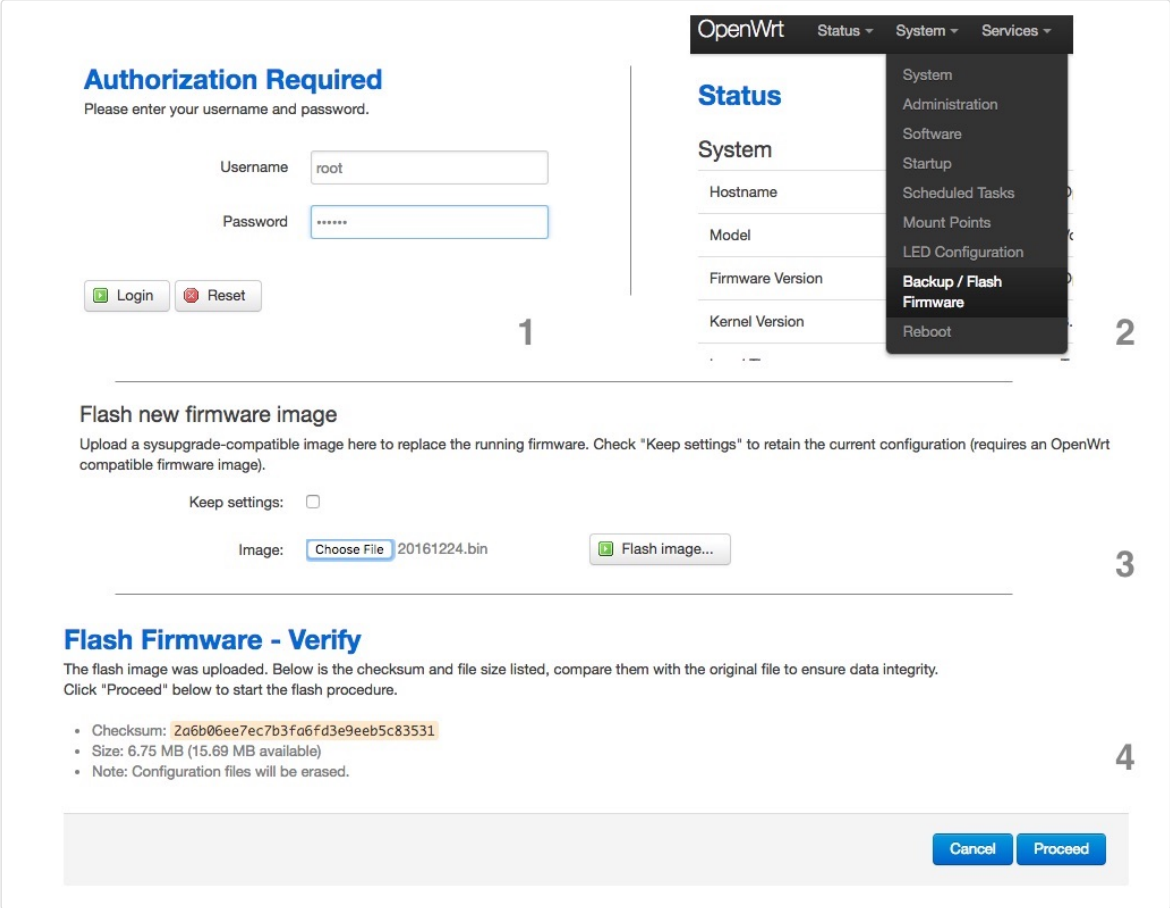
uci commit

note: better copy the three lines to /etc/rc.local

Upgrade VoCore2 Firmware

1. download the latest firmware(not the flash image) in this page Download section.

2. connect to your VoCore hotspot, open browser view 192.168.1.1 or 192.168.61.1.



3. LuCI console using username: root, password: vocore, click on "Login" (picture part 1).

4. select "System" -> "Backup/Flash Firmware" (picture part 2).

5. click on "Choose File", choose your downloaded firmware(again, not the flash image, picture part 3), then click "Flash Image".

6. it will upload the firmware to your VoCore2, takes a few seconds, check if the md5 matched. (picture part 4)

7. if everything ok, press "Process".

8. normally it will take 2~3 minutes, please wait until it is ready.

note: if power cut off during the upgrade process, your VoCore2 will brick, check "Fix Bricked VoCore2"

Compile OpenWRT for VoCore2

video tutorial: youtube (https://youtu.be/ocl6yFtKSNs)

1. install Ubuntu 14.04 64bit Server to Virtual Machine.

2. in virtualbox, we will need install some packages to compile openwrt:

sudo apt-get install gcc g++ binutils patch bzip2 flex bison make autoconf gettext texinfo unzip sharutils subversion libncurses5-dev ncurses-term zlib1g-dev libssl-dev python

3. download openwrt at "Sources" section in this page, software part.

4. call "tar -jxvf openwrt.tar.bz2" to uncompress the package.

5. call "make menuconfig" in the openwrt folder, configure openwrt in menu, choose MT7688/28/VoCore2 in menu.

6. call "make" in the openwrt folder, start the make process

Compile your App for VoCore2

1. compile openwrt for VoCore2, it will create toolchain or download it at Downloads/Toolchain(for Ubuntu 14.04 64bit).

2. make a simple code in C, compile it in command line.

```
/path.to.your.toolchain/bin/mipsel-openwrt-linux-gcc -g yourcode.c -o yourcode
```

3. after this, you will get an executable file named "yourcode", use scp, copy it to your VoCore2

4. in VoCore2, call `chmod +x yourcode` , after that, you can run it in VoCore2, call `./yourcode`

Upload Firmware

1. upload firmware through luci, please read "Upgrade Firmware" section.

2. upload firmware through console, connected to VoCore hotspot.

(1) copy from pc to VoCore[operate in PC]: scp [your firmware].bin root@192.168.61.1:/tmp/vocore2.bin

here is two choices, 2.a will erase all data/config you write to VoCore, 2.b just upgrade the firmware but keep them.

(2.a) write to VoCore nor flash[operate in VoCore]: mtd -e firmware write /tmp/vocore2.bin firmware

(2.b) system upgrade VoCore nor flash[operate in VoCore]: sysupgrade /tmp/vocore2.bin firmware

(3) wait until mtd done, reboot your VoCore.

note: if you want set your VoCore back to first time boot up, call "firstboot" in console.

Fix Bricked VoCore2 (uboot alive)

1. connect your VoCore2 to computer through USB2TTL(UART2 RXD2+TXD2+GND).

2. open tty tools(must have kermit protocol), such as kermit, ckermit.

3. power up your VoCore, once you find: "0: Load system code then write to Flash via SERIAL.", press '0'.

note: VoCore will show "## Ready for binary (kermit) download to 0x80100000 at 115200 bps..."

note: kermit: press Ctrl and '\' same time then press 'c', you will switch to kermit command console.

5. send upgrade firmware to VoCore, after that, back to VoCore uboot console.

note: kermit: call "send path/to/your/upgrade/file/on/pc.bin" to send firmware, around 10 minutes, once it finished, call 'c' back to console.

6. wait around 20~30 seconds, firmware uploaded, your VoCore will reboot.

Fix Bricked VoCore2 (uboot dead)

1. You must have another VoCore/VoCore2 or one flash loader and six wires.

2.1 using another VoCore/VoCore2 to recover your bricked VoCore2.

2.1 check blog http://vonger.cn/?p=8054.

2.2 using flash loader to recover your bricked VoCore2.

2.2.a disconnect VoCore2 from power;

2.2.b connect VoCore2 GND to flash loader GND;

2.2.c VoCore2 +3.3V to flash loader +3.3V;

2.2.d VoCore2 SPI MISO -> flash loader SPI MISO;

2.2.e VoCore2 SPI MOSI -> flash loader SPI MOSI;

2.2.g VoCore2 SPI CS0 -> flash loader SPI CS;

2.2.h VoCore2 SPI CLK -> flash loader SPI CLOCK;

2.2.i VoCore2 RST -> VoCore2 GND; (keep VoCore2 in reset mode)

note: if not work, swap MISO/MOSI.

2.2.j now, download then send "Flash Image" to VoCore2.2.

2.2.k remove wires, connect VoCore2 back to power, everything should back normal.

3. option: better to upgrade your firmware after recover, Flash Image is out of date.

Recover factory setting

Sometimes, we might mess the factory setting section on VoCore2 flash(address can be find by "cat /proc/mtd"), that will cause wifi driver failed to start. To recover it, we need the following steps:

---

1. get into VoCore console, by ehternet or serial port(TTL).

2. copy mt7628.sh (http://vonger.cn/misc/vocore2/tools/mt7628.sh) to your VoCore2 /tmp, or directly copy the txt in the script and run in console.

3. run mt7628.sh by "sh /tmp/mt7628.sh", then reboot.

note: your mac address will be fixed to b8:d8:12:67:01:73, you can change this to modify your VoCore2 mac address.

Update UBOOT from serial port

1. reboot vocore2 at serial console, check "Connect to VoCore through USB2TTL"

2. once reboot, it will show "7: Load Boot Loader code then write to Flash via Serial.", now we are ready to send the data.

3. use kermit or compatible tools send uboot.bin, uboot.bin can be get from from Download section.

4. wait until it reboot.

Directly write to memory/register

We made a simple tool for this, download here (http://vonger.cn/misc/vocore2/tools/mem.zip), its name is "mem", put the executable file into /bin/ in VoCore2.

1. read from register/memory, for example: 0x10000060, pin control register

example: `mem 0x10000060`

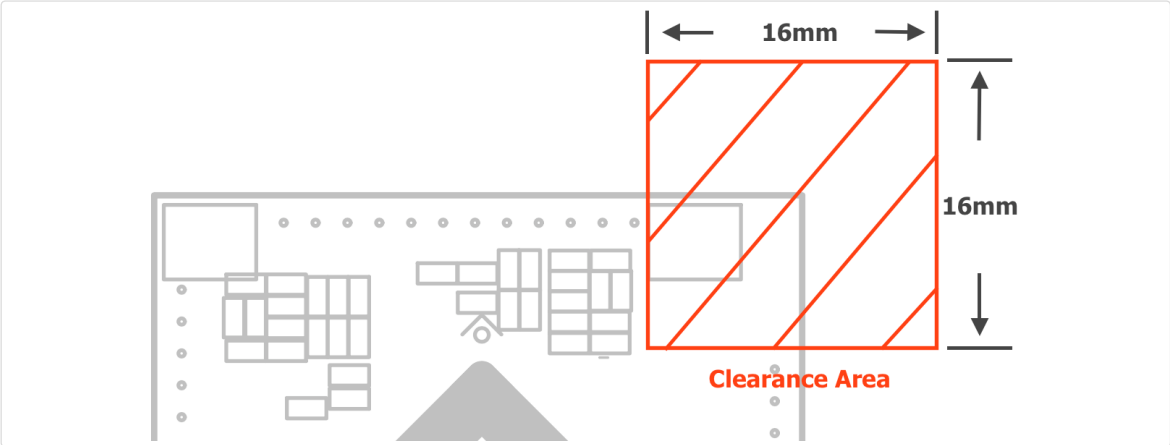
2. write to register/memory, must in 32bits(4bytes)

example: `mem 0x10000064 0x05540555`

here is an example bash script flash the LED every second on VoCore2

```
mem 0x10000064 0x05540555; mem 0x10000604 0x1000; while [ 1 ]; do mem 0x10000634 0x1000; sleep 1; mem 0x10000644 0x1000; sleep 1; done
```

Mount VoCore2 onto customized PCB(ASMT)



1. on customized PCB, **suggest** keeping 16mm x 16mm rectangle clearance(no copper) for better signal on board antenna.

2. **suggest** using hot air instead of iron, DDR2 is a ESD sencetive part, might cause permanent damage.

3. **must** use middle level temprature paste(180C, Sn-Bi-Ag) or lower one, VoCore2 is using high-temprature paste(220C, Sn-Cu-Ag), same temprature level might cause damage to VoCore.

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FCC Statement

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: this equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

● Reorient of relocate the receiving antenna.
● Increase the separation between the equipment and receiver.
● Connect the equipment into an outlet on a circuit difference from that to which the receiver is connected.
● Consult the dealer or an experienced radio/TV technician for help.

Important Note:

Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Country Code selection feature to be disabled for products marketed to the US/Canada.

1. The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2. The transmitter module may not be co-located with any other transmitter or antenna.

As long as the three conditions above are met, further transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Important Note:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

Any company of the host device which install this modular with limit modular approval should perform the test of radiated emission and spurious emission according to FCC part 15C:15.247 and 15.209 requirement, only if the test result comply with FCC part 15.247 and 15.209 requirement, then the host can be sold legally.

End Product Labeling:

The final end product must be labeled in a visible area with the following "Contains FCC ID: 2AC4RVOCOREV2"

Manual Information to the End User:

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

The modular is not intended to be fielded serviceable as without shielding, host manufacturer must be considered shielding when integrating a module.

When the module is installed inside another device, the user manual of this device must contain below warning

statements;

1. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
   (1) This device may not cause harmful interference.
   (2) This device must accept any interference received, including interference that may cause undesired operation.
2. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.