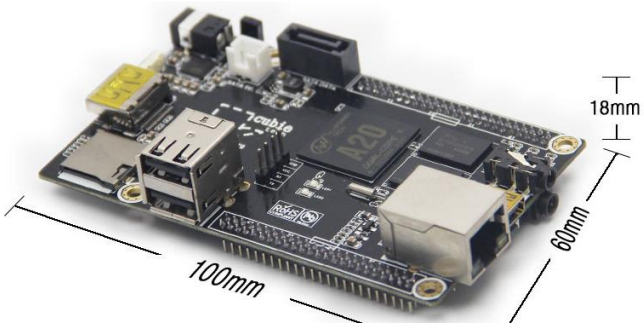

How to make an IoT server using Cubieboard2 and OpenWrt

Juozas Kimtys - How to make an IoT server using Cubieboard2 and OpenWrt

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Introduction

Main technical data of Single Board Computer module Cubieboard2: chipset is Allwinner A20 (two cores of ARM Cortex-A7 at speed 1GHz), 1GB RAM, micro-SD card slot, Ethernet, **no Wi-Fi**. Pitch of two 48-pins GPIO extension connectors is **2.0 mm**, not 2.54 mm. Manufacturers pages http://docs.cubieboard.org/tutorials/cb2/start and http://cubieboard.org/model/cb2/ contains links to information, but now only few of them are working. If to search on Internet actively, it is possible to find some information and to download already configured Linux like firmware images (most of them are very old). Links:

https://linux-sunxi.org/Cubietech_Cubieboard2

https://mega.nz/folder/ZtwxCCJC#AIYHcTqz-ucjuzKnE9qD7A/folder/I8x0GZrK

https://openwrt.org/toh/cubietech/cubieboard2

https://openwrt.org/toh/hwdata/cubitech/cubitech_cubieboard2

Links to hardware definition for Cubieboard2 for building other Linux images:

https://github.com/torvalds/linux/blob/master/arch/arm/boot/dts/sun7i-a20-cubieboard2.dts

https://github.com/linux-sunxi/sunxi-boards/blob/master/sys_config/a20/cubieboard2.fex

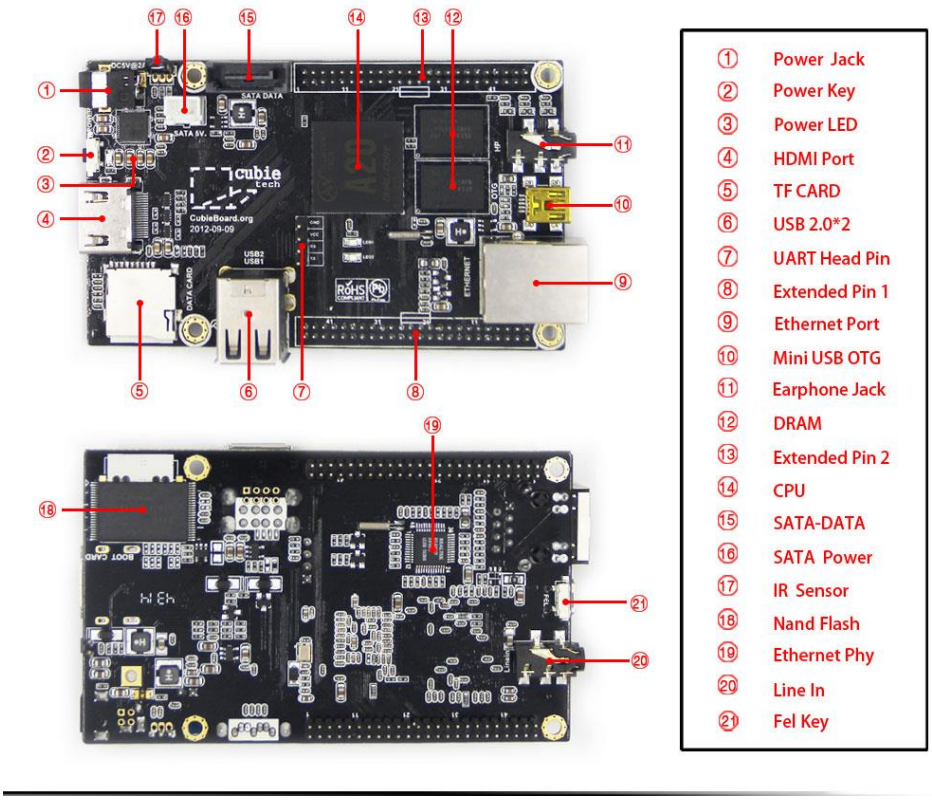


FIGURE 1 - OPTIONS OF CUBIEBOARD2 ON PICTURE FROM MANUFACTURER'S SITE

Boot options for Cubieboard2

Primary boot source by default is micro-SD card slot on top side of module. But some of modules may contain secondary boot option – boot from some memory on bottom side of the module. This memory on bottom side of the module can be of following variants: 1) some NAND chip, 2) eMMC chip of type SDIN7DP2-4G (Ultra NAND, managed NAND), 3) second micro-SD slot, 4) memory chip unsoldered after sale for various reasons. Thus, the system firmware can be “loaded” by using external micro-SD card writer on some desktop computer or by using the tool named PhoenixSuite (to “load” to soldered memory chip) through the OTG USB port (mini-USB connector on board).

Power options for Cubieboard2

There are at least two options to provide 5V to the module: 1) OTG USB port (mini-USB connector on board), 2) DC connector “4.0/1.7mm”. Current up to 2A is required in case of using external 2.5` HDD connected to SATA connector of the module.

Creating system card

There are available various Linux firmware distributions for Cubieboard2. But, after trying to work with about 8 years old Debian 7.1 or Cubian or Lubuntu, we will realize, that it is impossible to install any additional software or commands, or libraries – because most of links now do not work. Only **OpenWrt** distribution of Linux now is fresh and working on the Cubieboard2.

Writing system image to micro-SD card we are processing by using Ubuntu Desktop inside virtual machine (VMware Player) hosted on Windows PC.

Inserting USB adapter with inserted 16GB or 8GB micro-SD card to PC USB port. Note: do not use micro-SD or to SD card slot of your PC - because VMware virtual machine does not detect that slot. Make sure does the Ubuntu system shows up the card. Using the program Disks - removing all previously created partitions from the card. In Ubuntu files explorer - making right mouse click on the previously extracted system disk image file. Selecting option "Open With Disk Image Writer". Writing system image to the card. Note: it is required Ubuntu Desktop machine administrator's password (it is not available on "Try Ubuntu and install later" variant).

Our OpenWrt firmware file name is:

openwrt-22.03.3-sunxi-cortexa7-cubietech_cubieboard2-squashfs-sdcard.img

Using the program Disks - creating new partition of type Ext4 on available free space of the card.

Serial console

Below are the pictures of dialog in Realterm console. Default speed is “115200”, 8N1. Typing username **root** or **cubie** and password **cubieboard** into the console window to login to our Debian. Typing username **cubie** and password **cubie** into the console window to login to our Cubian. OpenWrt will automatically enters to session without requesting login.

FIGURE 2 - CONSOLE DIALOG OF DEBIAN. USERS: ROOT OR CUBIE, PASSWORD: CUBIEBOARD

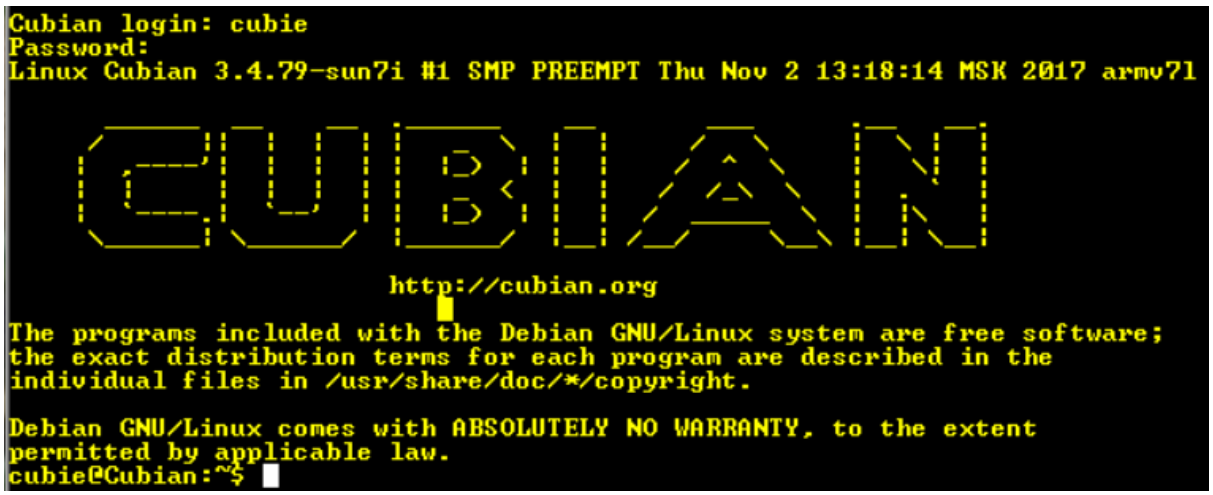


FIGURE 3 - CONSOLE DIALOG OF CUBIAN. USER: CUBIE, PASSWORD: CUBIE

FIGURE 4 - CONSOLE DIALOG OF OPENWRT

Making IP address of OpenWrt dynamic

Our development computer (Windows PC) is connected to Wi-Fi of Android tablet configured to emit Wi-Fi Hotspot from SIM card with allowing Internet data from 4G cellular network. As the

Cubieboard2 do not contains Wi-Fi interface, we use network extender “Wi-Fi to Wi-Fi and to Ethernet” of type Asus RP-N12. If we want to use SSH, and if we don’t want to change anything in our Wi-Fi hotspot settings, our Cubieboard2 must be in the same Ethernet network as our PC, and we must have dynamic IP address of our Cubieboard2. Note: sometimes, at first boot, the system OpenWrt already becomes configured as “dhcp”, but IP address from the DHCP server usually, in such case, is not obtained, regardless of the reboot. In such case we need to restart our DHCP server (Asus RP-N12).

```
root@OpenWrt:/# cd etc/config
root@OpenWrt:/etc/config# vi network
```

FIGURE 5 - GOING TO CONFIGURE NETWORK FROM 'STATIC' TO 'DHCP'

We are using text editor of type vi. Information about vi: there are two modes - command mode and insert mode, by default (after opening a document) it is a command mode, press ‘esc’ to switch from insert mode to command mode. In command mode:

- ‘:q!’ means exit without save,
- ‘8j’ will move the cursor down 8 lines,
- ‘8k’ will move the cursor up 8 lines,
- arrow right or left will move cursor right or left,
- ‘x’ - will delete char at current position,
- ‘i’ - every next entered char will appear before cursor, press ESC to stop inserting,
- ‘:w’ – write to file,
- ‘:wq’ – write to file and quit editor,
- ‘: w filename’ – writes to other file name.

More information about text editor of type vi: https://www.marquette.edu/mathematical-and-statistical-sciences/basic-vi-editor-commands.php

```
config interface 'loopback'
        option device 'lo'
        option proto 'static'
        option ipaddr '127.0.0.1'
        option netmask '255.0.0.0'

config globals 'globals'
        option ula_prefix 'fd74:ca7e:31b4::/48'

config device
        option name 'br-lan'
        option type 'bridge'
        list ports 'eth0'

config interface 'lan'
        option device 'br-lan'
        option proto 'dhcp'
        option ipaddr '192.168.1.1'
        option netmask '255.255.255.0'
        option ip6assign '60'
```

FIGURE 6 - CHANGING IP ADDRESS FROM ‘STATIC' TO 'DHCP' (SMALL CAPS ARE MANDATORY)

FIGURE 7 - AFTER REBOOT WE WILL SEE IP ADDRESS OF OUR SERVER

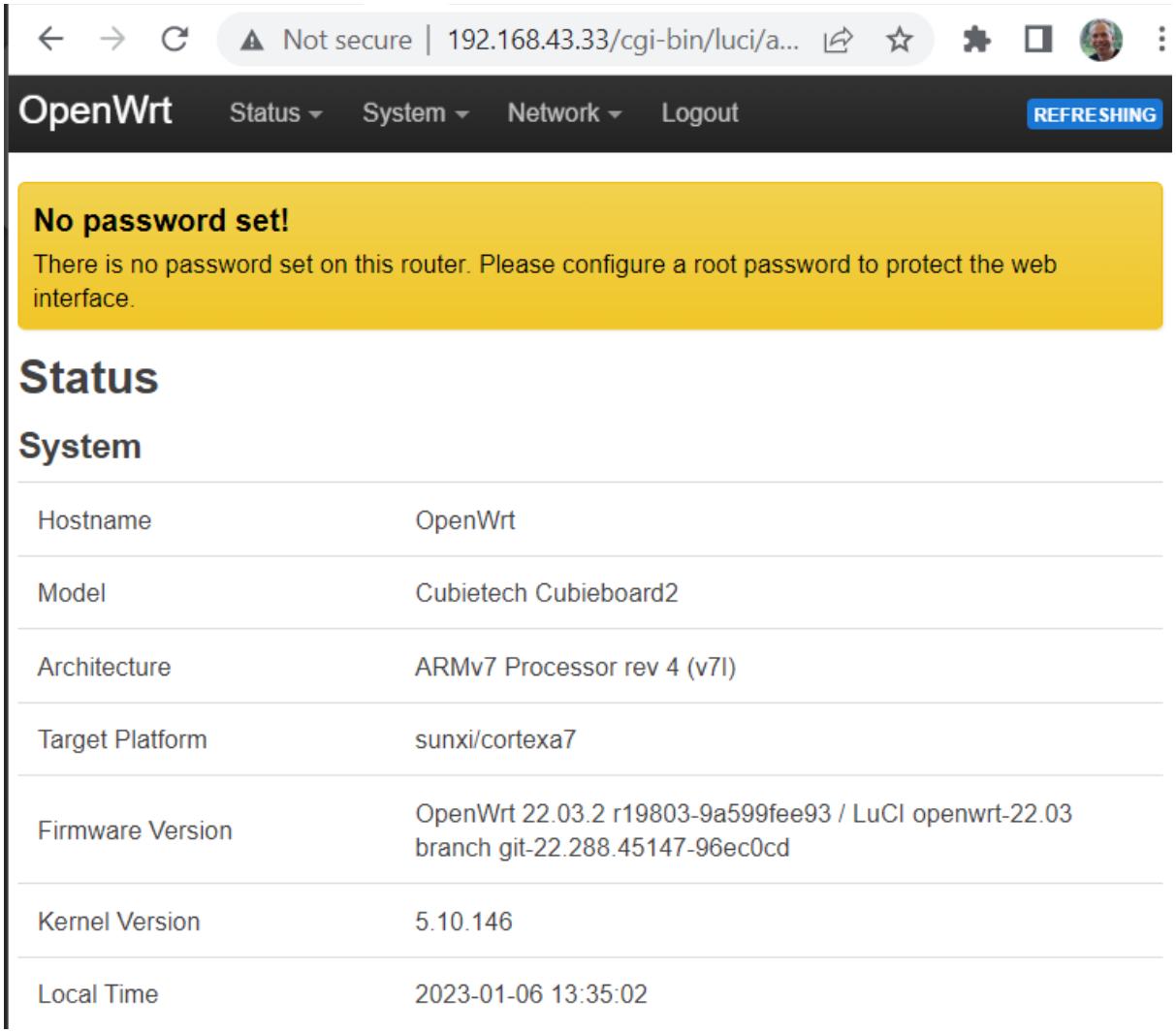


FIGURE 8 – OUR SERVER'S SETUP WEB PAGE ON INTERNET BROWSER OF OUR PC

Changing time zone of our server

We need to edit the file /etc/config/system. Using the string of time zone: 'EET-2EEST,M3.5.0/3,M10.5.0/4' , which means "Europe/Helsinki", but is also good for Vilnius. We may edit this setting file by using text editor vi and type each char of this string or may edit by using SSH and MobaTextEditor and PC clipboard.

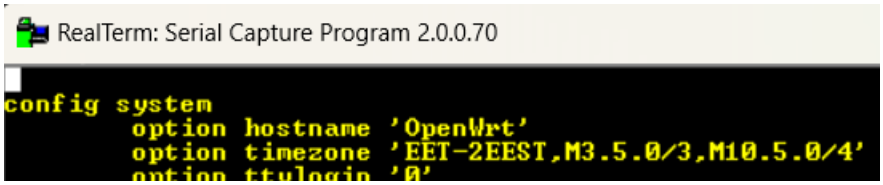


FIGURE 9 - CHANGING TIME ZONE FROM 'UTC' TO 'EET-2EEST,M3.5.0/3,M10.5.0/4' IN CONSOLE

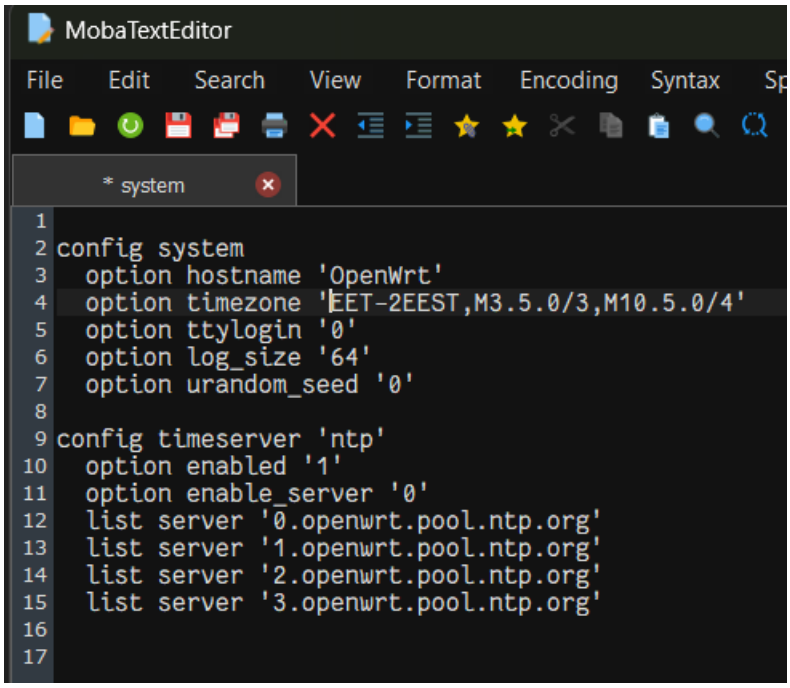


FIGURE 10 - CHANGING TIME ZONE BY USING MOBATEXTEDITOR

Same setting we can do by using web interface of our server. Note: In the web interface we will see correct time, but time zone still will be “UTC” - regardless of our edit. After changing in web interface and saving to “Europe/Vilnius”, new line appears in the file /etc/config/system:

option zonename 'Europe/Vilnius'

Expanding disk size of our OpenWrt server (not success)

For this task we will need to execute many scripts taken from Internet suggestions. It is better to use Windows Power Shell than Serial console, because Power Shell allows to use clipboard to copy-paste commands. To try to expand the disk, we are using suggestions from:

https://openwrt.org/docs/guide-user/installation/installation_methods/sd_card

https://forum.openwrt.org/t/expanding-openwrt-squashfs-image-sdcard/107711

In Windows Power Shell:

ssh root@192.168.43.33

root@OpenWrt:~# opkg update (next command will not work without this update)

root@OpenWrt:~# opkg install e2fsprogs fdisk resize2fs cfdisk

root@OpenWrt:~# opkg update && opkg install losetup

```
root@OpenWrt:~# losetup
NAME       SIZELIMIT  OFFSET AUTOCLEAR RO BACK-FILE  DIO LOG-SEC
/dev/loop0         0 3145728         1  0 /mmcblk0p2   0     512
```

FIGURE 11 - CONSOLE DIALOG AFTER ENTERING THE COMMAND *LOSETUP*

root@OpenWrt:~# cfdisk /dev/mmcblk0

After last step we will have (in Windows Power Shell):

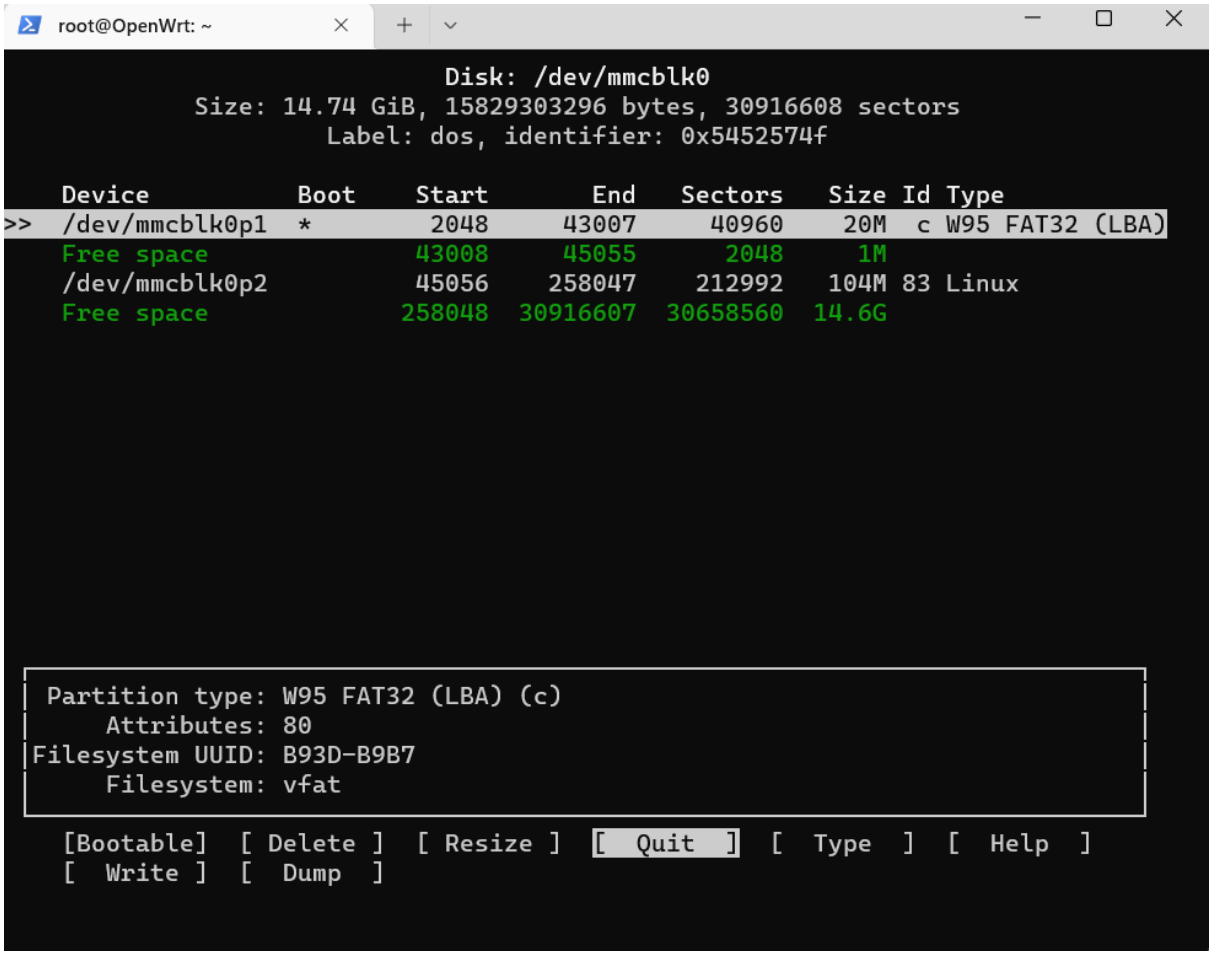


FIGURE 12 - DIALOG WINDOW AFTER ENTERING CFDISK /DEV/MMCBLK0

Create a NEW PRIMARY partition in the free space at the end. Delete this new partition. Select /dev/mmcblk0p2 and RESIZE it. The default entries will take the whole space.

Write -> 'yes' -> Quit

After we will have:

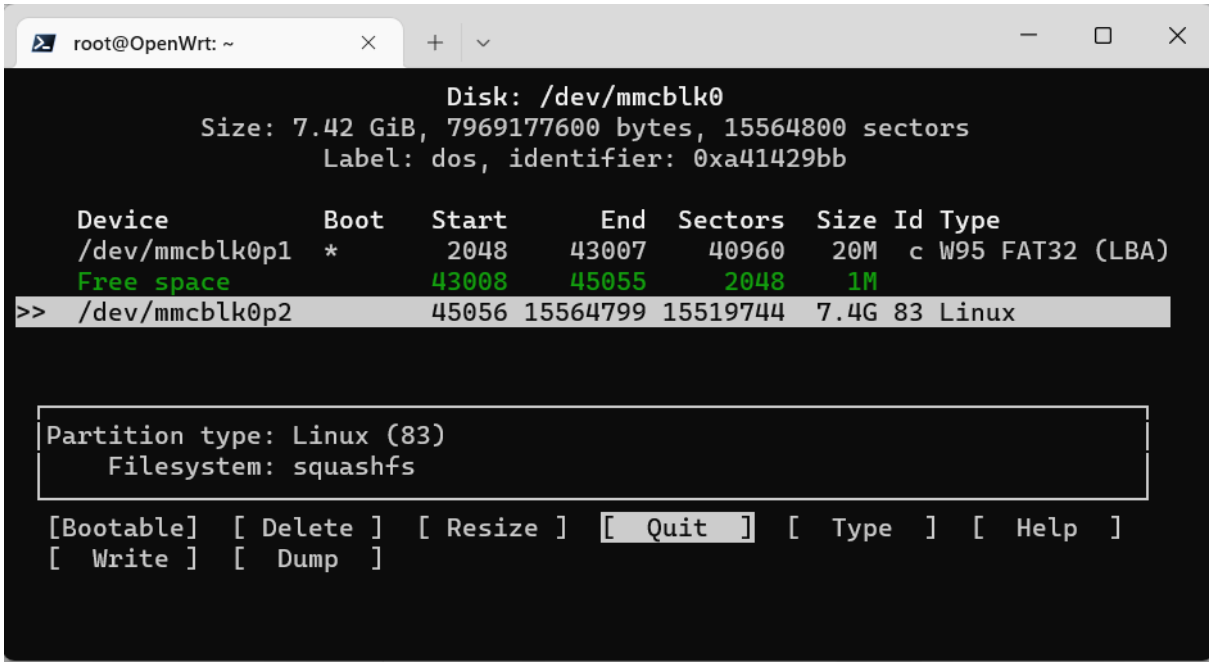


FIGURE 13 - CONSOLE DIALOG AFTER PARTITION RESIZING

root@OpenWrt:~# reboot

ssh root@192.168.43.33

opkg update

opkg install dosfstools

root@OpenWrt:~# resize2fs /dev/loop0

Error message:

resize2fs 1.46.5 (30-Dec-2021)

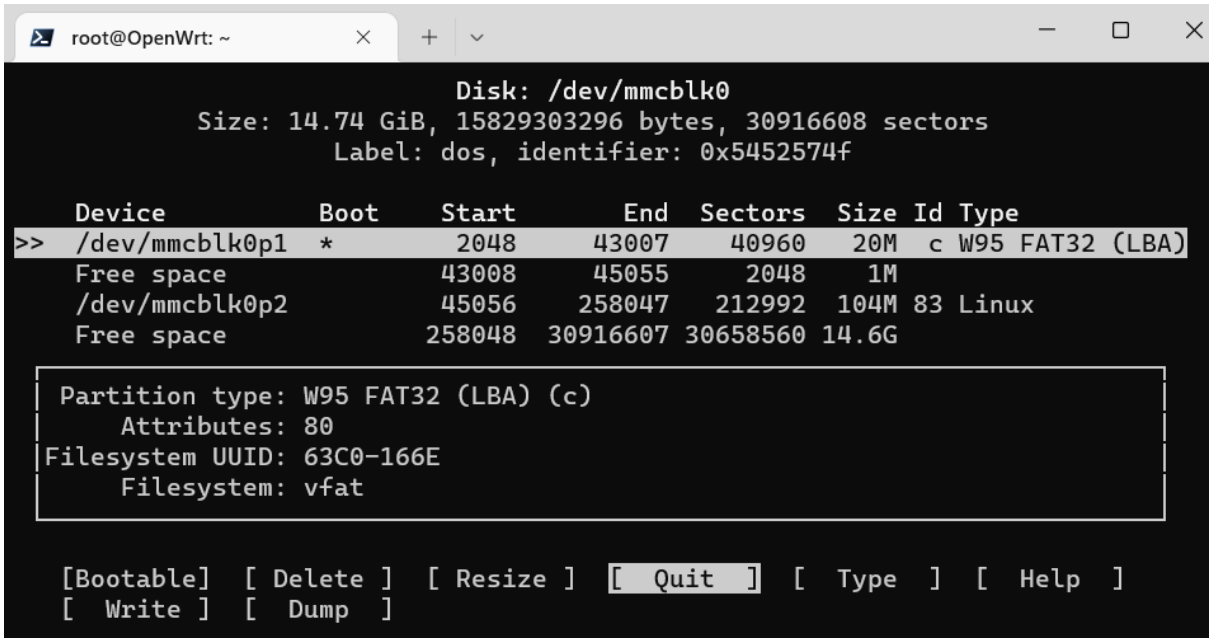
resize2fs: Bad magic number in super-block while trying to open /dev/loop0

Couldn't find valid filesystem superblock.

https://openwrt.org/docs/guide-user/additional-software/opkg#examples

opkg update

opkg install losetup



Conclusion

At the date main image of OpenWrt for Orange Pi i96 is not useful (openwrt-22.03.3-sunxi-cortexa7-cubietech_cubieboard2-squashfs-sdcard.img) , because it is impossible to extend disk partition in OpenWrt system when there are two disks – one read only and other writable. We must learn more about Linux loop devices - to be able understand what is wrong with extending of writable partition. Without extending of partition, it is impossible to install any bigger program (like Apache Web server).

At the date exists other image – image of type snapshot, that contains only one disk partition. For this system we are easy able to extend partition. But the problem is that system creator does not include LuCi interface. Without this interface it is very difficult to keep dependencies of newly installed programs.

Stopping to try with OpenWrt.

Revision History

Version	Date	Comments
ver.1.0	2023.01.05	Initial release
		○