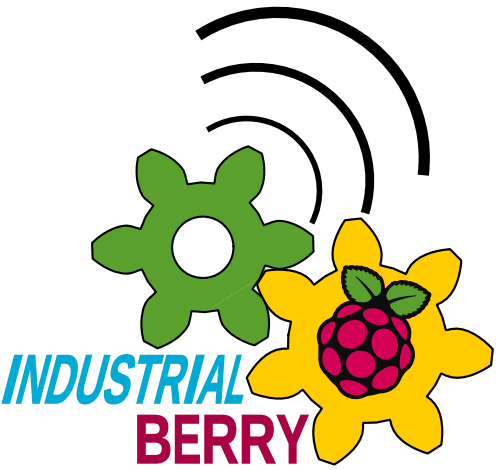
EthernetBerry Dual PI V 1.1



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Chapter 1

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- Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Chapter 2

Introduction

EthernetBerry Dual Pi V 1.1 is an extension board for RaspBerry Pi. It is an Open Hardware Design. It has two functionalities: a dual Ethernet interface and an on board Real Time clock powered by a 12 mm battery. In fig 2.1 is shown the Board Top View.

The Ethernet is based on ENC28J60 [2] SPI controller. All functionalities are full integrated in standard linux kernel, so, they can be available on fly, or at last recompiling linux kernel to add Ethernet functionalities. The real time clock is based on DS3231 [3] an I2C controller with internal oscillator. It is full compatible with linux too. Using I2C Kernel module, and standard kernel functions, date and hour can be set/get by simple commands. On the bottom side is located an on board battery to guarantee a data autonomy more than 20 years. In chapter hardware there are all informations on principal components, schematics to rebuild and modify RaspBerry PI board. In chapter Software is reported how all hardware can be used: as recompile kernel, build simple user space function to set and get I2C data, etc... In chapter application is reported a typical example of how to use the board.

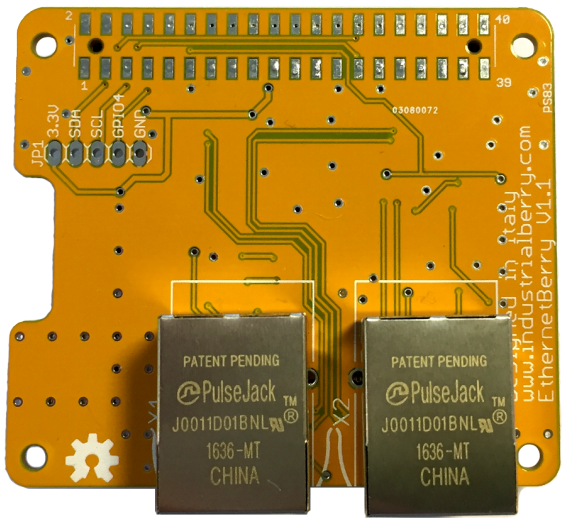

Figure 2.1: EthernetBerry Dual V1.1 Top view

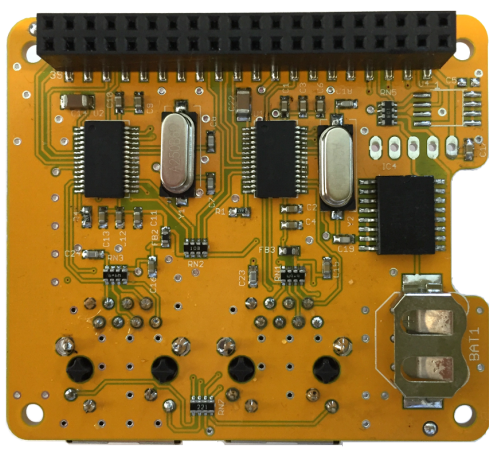

Figure 2.2: EthernetBerry Dual V1.1 Bottom view

Chapter 3

Hardware implementation

EthernetBerry Dual PI 1.1 is composed by three blocks: two Ethernet Modules (ENC28J60 U1 shown in Fig. 3.2 and ENC28J60 U2 shown in Fig. 3.3) and a Real Time Clock shown in 3.8. The ENC28J60 is a stand-alone Ethernet controller with an industry standard Serial Peripheral Interface (SPI). It is designed to serve as an Ethernet network interface for any controller equipped with SPI [2]. The ENC28J60 meets all of the IEEE 802.3 specifications and it is full integrated in linux kernel. At the start, the driver was implemented as a block device. Recently it is assumed to be a network module into the kernel.

A typical connection of bus controller is displayed in Fig. 3.1. On Raspberry Pi connector (fig 3.9) we have the following connection:
Power:

- 3.3V from PIN 1
- 3.3V from PIN 17
- GND from PIN 6
- GND from PIN 9
- GND from PIN 14
- GND from PIN 20

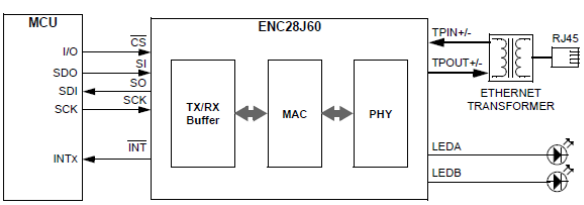

Figure 3.1: Typical ENC28J60 based interface

- GND from PIN 25
- GND from PIN 30
- GND from PIN 34
- GND from PIN 39

U1 3.2 is connected on SPI.0 :

- MOSI.0 from PIN 19
- MISO.0 from PIN 21
- SCLK.0 from PIN 23
- SPI0.CE0 from PIN 24
- INT from PIN 15

U2 3.3 is connected on SPI.1 :

- MOSI.1 from PIN 38
- MISO.1 from PIN 35
- SCLK.1 from PIN 40
- SPI1.CE0 from PIN 12
- INT from PIN 22

The X1 and X2 are classical transformer isolated ethernet connectors, for our project we have selected the J0011D01BNL[1] by Pulse Electronics.

The fig. 3.5 show the internal schematic of RJ45 connector.

The Raspberry Pi B+/B3 has been designed specifically with add-on boards in mind and today we are introducing HATs (Hardware Attached on Top).

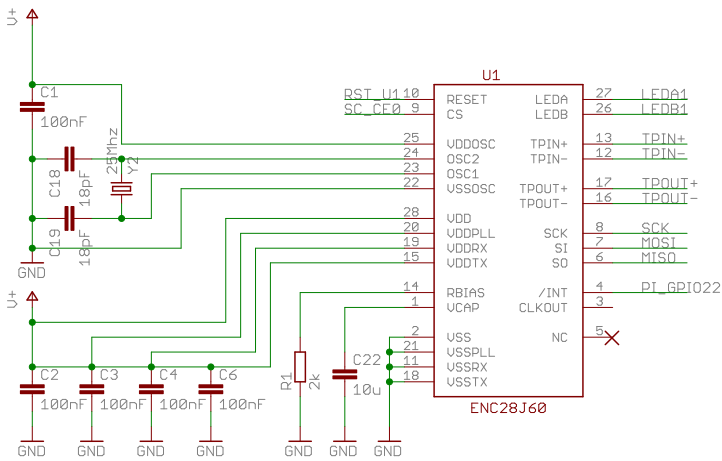

Figure 3.2: Electric diagram of Ethernet 1 block

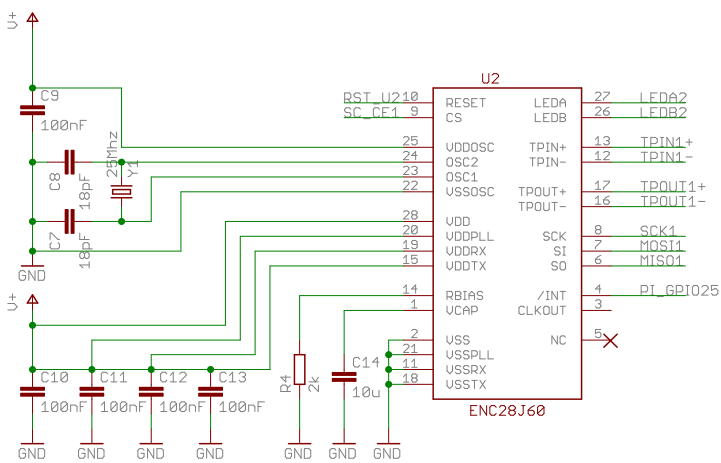

Figure 3.3: Electric diagram of Ethernet 2 block

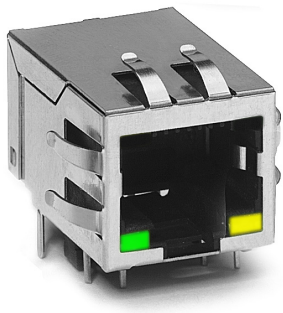

Figure 3.4: Connetor RJ45[1]

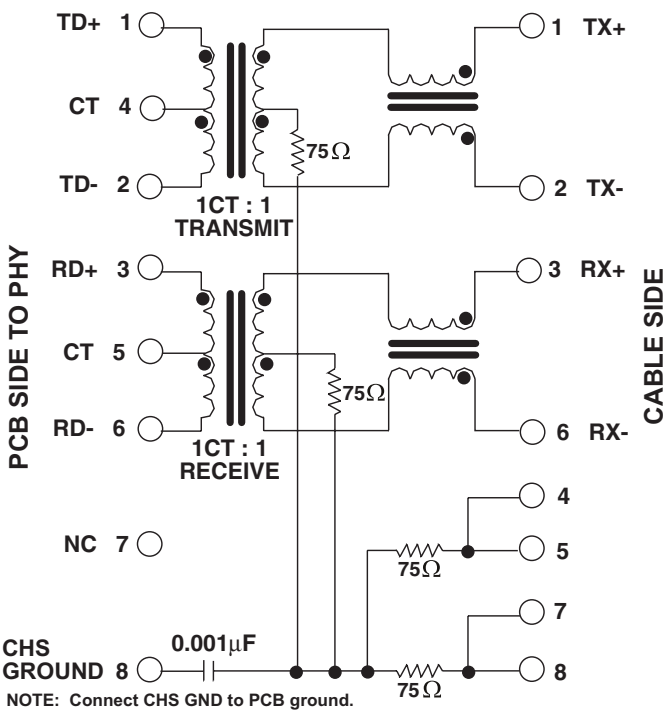

Figure 3.5: Internal schematic of RJ45[1]

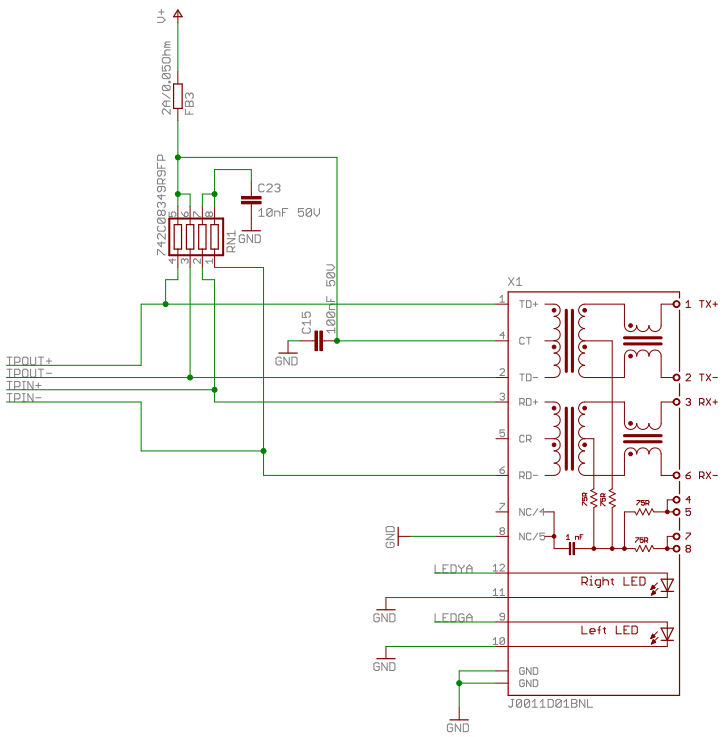

Figure 3.6: Connetor RJ45 X1

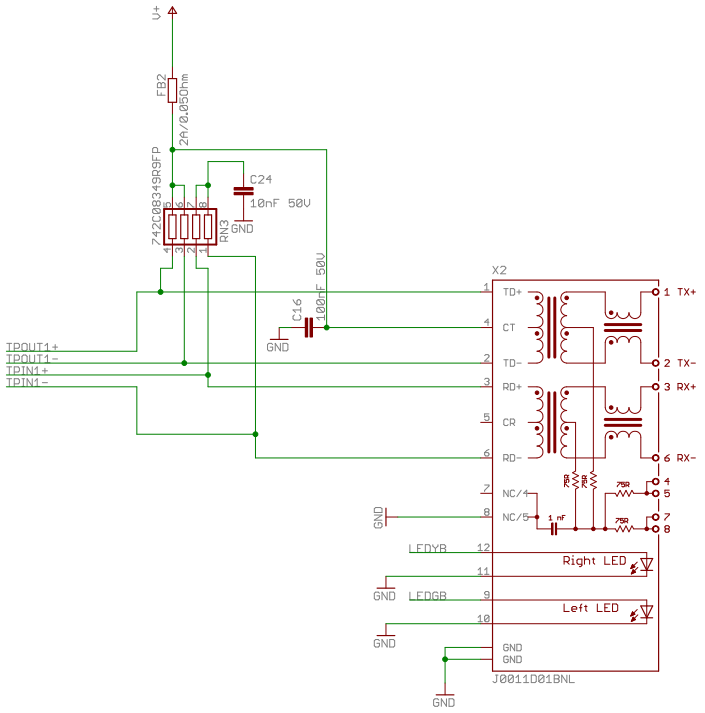

Figure 3.7: Connetor RJ45 X2

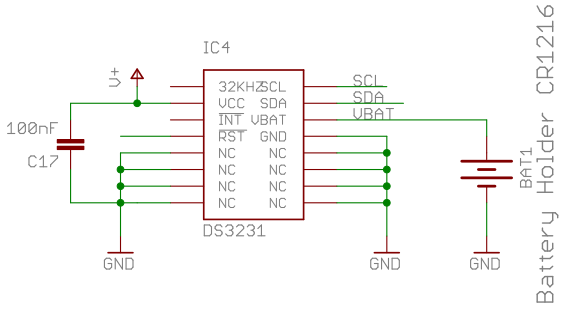

Figure 3.8: Electric diagram of RTC block

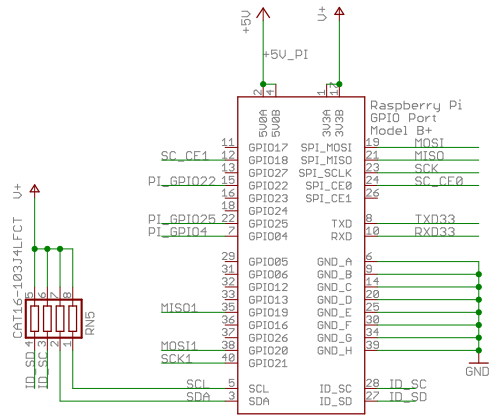

Figure 3.9: EthernetBerry Dual Connector

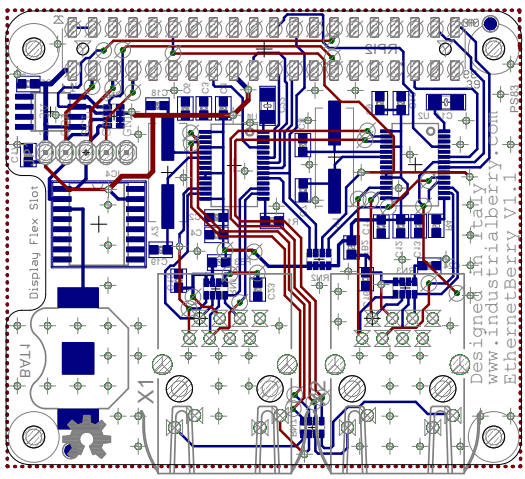

Figure 3.10: EthernetBerry Dual Layout

Chapter 4

Software implementation

Install RASPBIAN JESSIE (kernel 4.4 or newer) from raspberry official website for Rpi B3 and B2.
Download and copy EtherBerry configuration tools (**conf_sgs_eth2.tar.gz**) to your Raspberry from:

```
https://drive.google.com/uc?export=
download&id=0BxqrZloyewyaeU8zdFRiWEQ2MXc
```

Uncompress conf_sgs_eth2.tar.gz:

```
pi@raspberrypi ~ $ tar zxvf conf_sgs_eth2.tar.gz
```

Wait that uncompressed process finished...
Goto to directory conf_sgs_eth2:

```
pi@raspberrypi ~ $ cd conf_sgs_eth2
```

Check files in directory conf_sgs_eth2 (**conf_sgs_eth2.sh** , **sgs_enc28j60-spi1.dtbo**) with **ls**:
Run the bash script:

```
pi@raspberrypi ~/conf_sgs_eth2 $ sudo sh conf_sgs_eth2.sh
```

Wait excution script finished...
Reboot Raspberry:

```
pi@raspberrypi ~/conf_sgs_eth2 $ sudo reboot
```

After Raspberry Reboot check the network interfaces available with the command **ifconfig**, in the list of the network interfaces (fig. 4.7) will be available the eth1 and eth2 network interfaces provided by EthernetBerry board.
For example: to set the static ip on the networks interfaces, edit the interfaces file with the command:

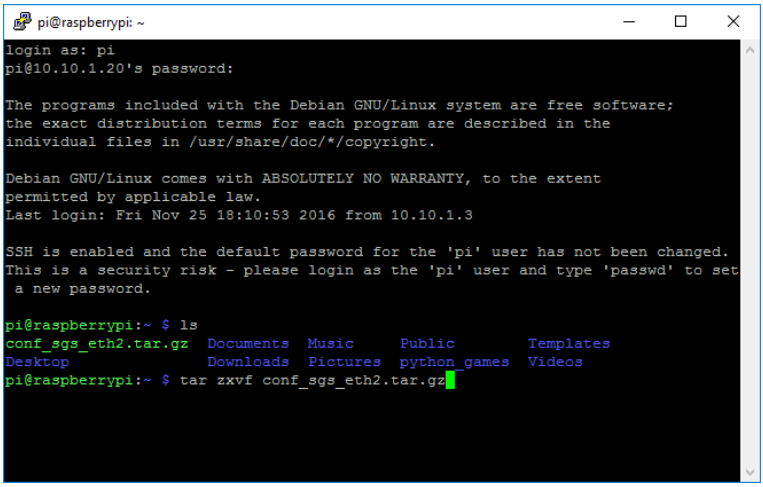

Figure 4.1: Uncompress conf_sgs_eth2.tar.gz

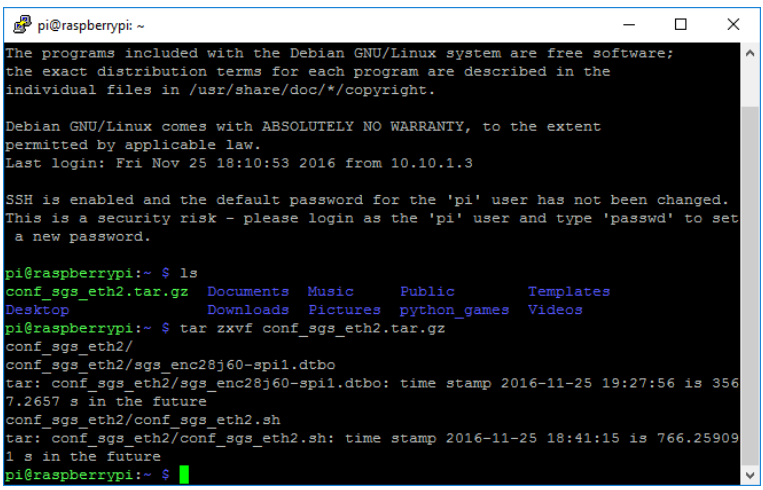

Figure 4.2: Wait that uncompressed process finished

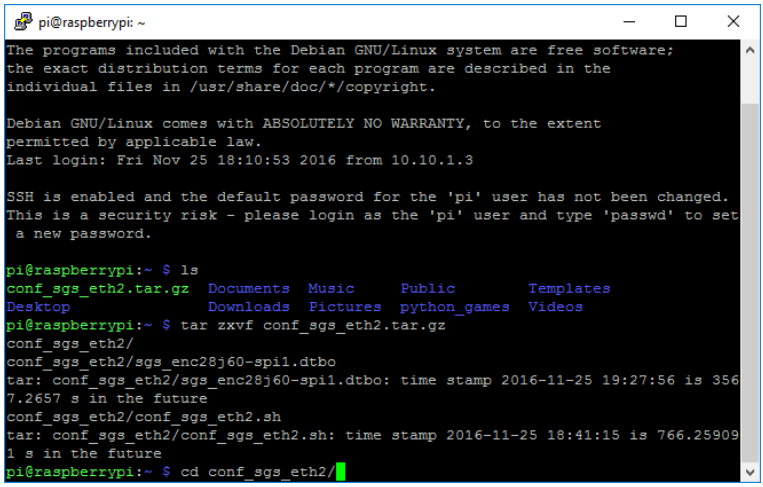

Figure 4.3: Goto directory

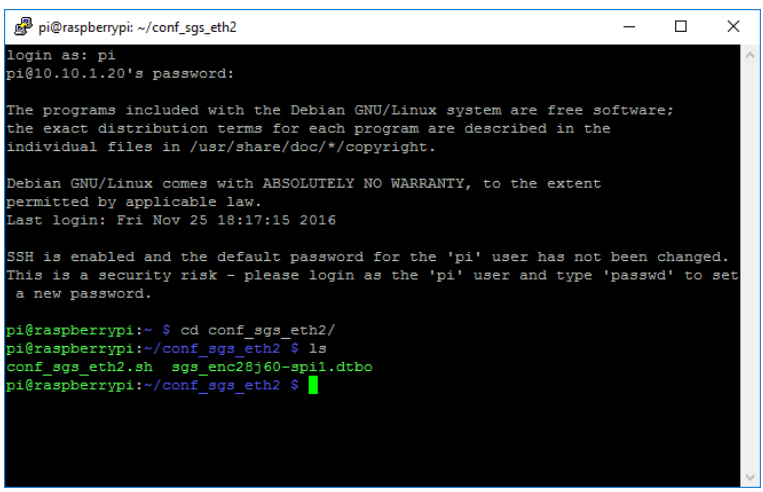

Figure 4.4: Check files

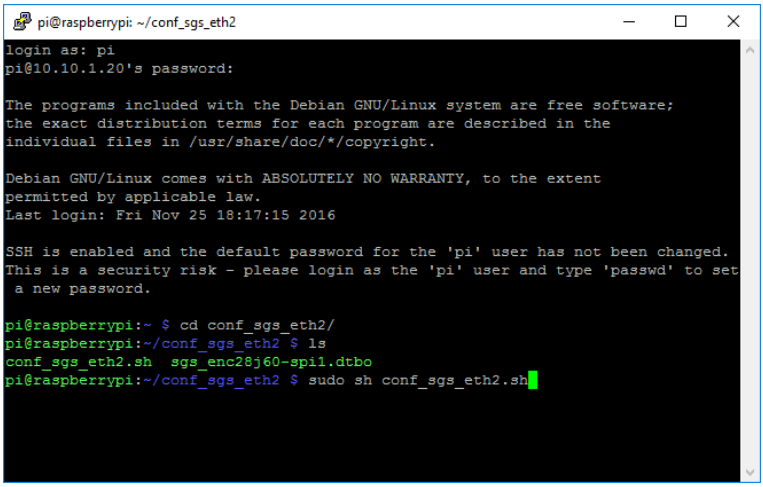

Figure 4.5: Run script

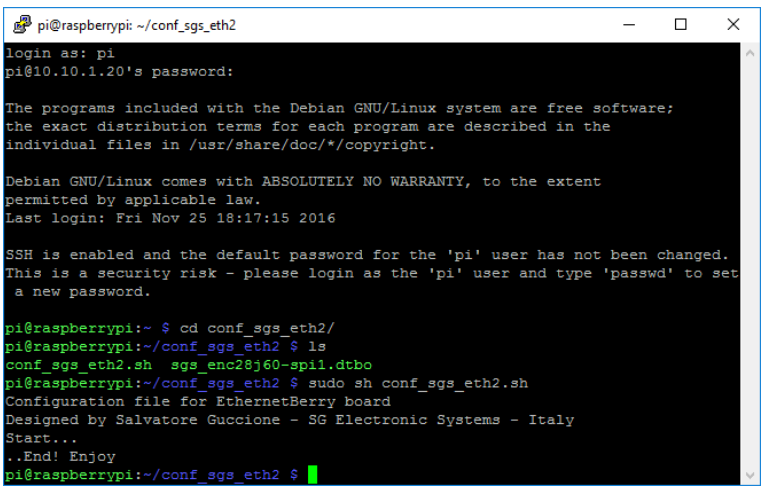

Figure 4.6: Wait script finishied

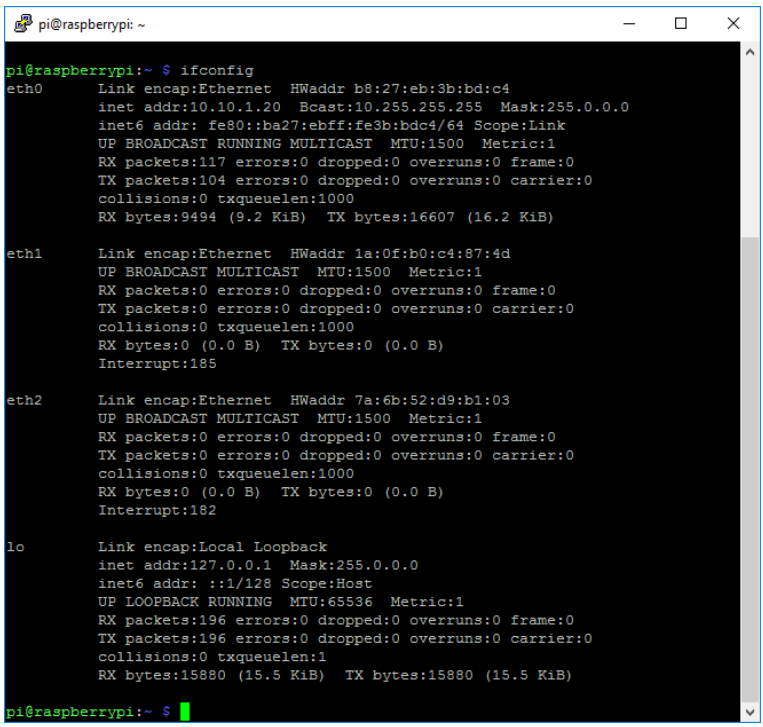

Figure 4.7: Interfaces list

```
pi@raspberrypi ~ $ sudo nano /etc/network/interfaces
```

Add the lines reported below with your settings and save:

```
auto eth1
iface eth1 inet static
    address 192.168.16.10
    netmask 255.255.255.0
    network 192.168.16.0
    broadcast 192.168.16.254
    post-up route add default gw 192.168.16.1 metric 2
    pre-down route del default gw 192.168.16.1

auto eth2
iface eth2 inet static
    address 192.168.16.13
    netmask 255.255.255.0
    network 192.168.16.0
    broadcast 192.168.16.254
    post-up route add default gw 192.168.16.1 metric 2
    pre-down route del default gw 192.168.16.1
```

Reboot Raspberry.

4.1 Real Time Clock

It is possible use the RTC IC with the terminal or with a compiled program. The DS1307Z is a device I2C, and then we must install **i2c-tools**

```
sudo aptitude install i2c-tools
```

and **libi2c-dev** before use it.

```
sudo aptitude install libi2c-dev
```

4.1.1 RTC with shell

The following code allow the management of the RTC with the i2c-tools directly from the shell. Verify the DS1307Z address 0x68 with

```
sudo i2cdetect -y 0
```

for Raspberry Rev 1 or

```
sudo i2cdetect -y 1
```

for Rev 2 and B+, because the I2C bus address changed from 0 to 1.

Run the scripts as root:

```
modpro be rtc-ds1307
```

Then, run

```
echo ds1307 0x68 > /sys/class/i2c-adapter/i2c-0/new_device (if you have
    a Rev 1 Pi)
```

```
echo ds1307 0x68 > /sys/class/i2c-adapter/i2c-1/new_device (if you have
    a Rev 2 Pi)
```

Set RTC with

```
hwclock -w
```

Read RTC with

```
hwclock -r
```

4.2 LED Control

Go to home directory:

```
cd /home/pi/
nano gpio_on.sh
```

add these lines to the script

```
#!/bin/sh


# Set up GPIO 27 and set to output
echo "27" > /sys/class/gpio/export
echo "out" > /sys/class/gpio/gpio27/direction

# Set up GPIO 4 and set to output
echo "4" > /sys/class/gpio/export
echo "out" > /sys/class/gpio/gpio4/direction

# Write output
```

```
#Led1 On
echo "1" > /sys/class/gpio/gpio27/value
#Led2 On
echo "1" > /sys/class/gpio/gpio4/value

# Clean up
echo "27" > /sys/class/gpio/unexport
echo "4" > /sys/class/gpio/unexport
```

```
nano gpio_off.sh
```

add these lines to the script

```
#!/bin/sh


# Set up GPIO 27 and set to output
echo "27" > /sys/class/gpio/export
echo "out" > /sys/class/gpio/gpio27/direction

# Set up GPIO 4 and set to output
echo "4" > /sys/class/gpio/export
echo "out" > /sys/class/gpio/gpio4/direction

# Write output
#Led1 Off
echo "0" > /sys/class/gpio/gpio27/value
#Led2 Off
echo "0" > /sys/class/gpio/gpio4/value

# Clean up
echo "27" > /sys/class/gpio/unexport
echo "4" > /sys/class/gpio/unexport
```

Run the scripts as root:

```
sh gpio_on.sh
sh gpio_off.sh
```

Chapter 5

Components list

In the table 5.1 we can see the Bill of Material for the board, all the components are available on-line. For simplicity, every component has a Mouser order code (www.mouser.com).

Qty	Value	Package	Parts	Mouser-cod	Cost N	Cost T €
14	100nF	0603	C1, C2, C3, C4, C5, C6, C9, C10, C11, C12, C13, C15, C16, C17	445-1316-1-ND	0,10	1,40
2	10nF 50V	0603	C23, C24	77-VJ0603Y103KXACBC	0,06	0,12
2	10uF	1206	C14, C22	81-GRM31CR71E106MA2L	0,23	0,92
4	18pF	0603	C7, C8, C18, C19	77-VJ0603A180JXACBC	0,06	0,24
2	25Mhz	HC49/US	Y1, Y2	815-ABLS-25-B2	0,32	0,64
2	2A 0.05Ω	0603	FB2, FB3	81-BLM18EG221SN1D	0,21	0,42
2	2 kΩ	0603	R1, R4	71-CRCW0603-2.0K-E3	0,09	0,09
1	499 Ω	1206	RN7	CAT16-4990F4LF	0,22	0,22
2	49,9 Ω	1206	RN1, RN3	CAY16-49R9F4LF	0,16	0,32
2	10 kΩ	1206	RN2, RN5	CAT16-103J4LFCT	0,10	0,20
1	DS3231	SOIC16	IC4	DS3231S#-ND	8,35	8,35
2	ENC28J60	SSOP28	U1, U2	579-ENC28J60/SS	3,16	6,32
1	EEPROM24-NC	SOIC8	U4	556-AT24CS32-SSHM-T	0,32	0,32
2	J0011D01BNL	RJ45	X1, X2	673-J0011D01BNL	7,47	14,94
1	RETAINER COIN 12MM	BAT100	BAT100	BAT-HLD-012-SMT-ND	0,27	0,27
1	Header 40 pos	2 x 20		SAM1086-20-ND	3,30	3,30
1				PCB	4,20	4,20
				Tot		42,27

Table 5.1: EthernetBerry Dual Pi V 1.1

Bibliography

[1] Pulse Electronics. *J0011D01BNL Datasheet*. http://productfinder.pulseeng.com/files /datasheets/J403.pdf.

[2] Microchip. *ENC28J60 Datasheet*. http://ww1.microchip.com/downloads/en /DeviceDoc/39662c.pdf.

[3] Maxim. *DS3231 Datasheet*. http://datasheets.maximintegrated.com/en/ ds/DS3231-DS3231S.pdf.