

Setup Wireless LAN (WLAN) on the Raspberry Pi

1. Introduction

Adding a wireless LAN connection to the Raspberry Pi (RPI) requires only a USB wireless access device (also called WLAN dongle and Wi-Fi dongle) and some changes to the network interface configurations. The following steps assume the RPI is initially connected to the LAN through a wired Ethernet cable. DO NOT plugin the Wi-Fi dongle until instructed to do so. As you go through the following steps, take screenshots before and after making changes – this will help in case you make a mistake and need to reverse your changes.

A Wi-Fi dongle derives power from the RPI USB port and this power is in addition to that required by the RPI itself. A typical Wi-Fi dongle adds about 30 mA to the RPI load current. A power supply that is adequate for the RPI alone may not be adequate for the RPI and a Wi-Fi dongle. A power supply with at least 5 W capacity (≥ 1 A at 5 Vdc) should be used. The dongle should be plugged into the USB port BEFORE power is applied to the RPI; otherwise, the RPI may spontaneously reboot because of the momentary voltage drop on its power bus, possibly resulting in program corruption. This design deficiency is especially apparent in the RPI model B but much less so in the model B+.

2. WLAN Dongle

WLAN dongles are inexpensive and easy to obtain; for example, the Edimax EW-7811Un Nano, 150 Mb/s 802.11n Wi-Fi USB Adapter costs 7 USD. These devices have a very small antenna so their range is limited but ≥ 3 m between the dongle and a wireless router or wireless access point should be achievable in most situations.



Note: USB BlueTooth and Zigbee dongles are physically identical to the Wi-Fi dongle but are not compatible. Most current Wi-Fi dongles are marked 802.11n and they are backward compatible with 802.11b and g.

Caution: Some WLAN dongles use power management by default and they will go into sleep mode after a period of inactivity. Sleep mode is manifested as a “dead” Wi-Fi connection from which the device will not recover without rebooting the RPI. This is a well-known problem when these devices are used in the RPI, and the solution depends on the chipset used in the dongle itself. The procedures given here include a configuration file that solves this problem for the RealTek 8192cu/RTL8188CUS chipset used in many Wi-Fi dongles. If your Wi-Fi dongle has that chipset or is compatible with it, you should not have any problems. If your WLAN device does not operate reliably then you may have to revert to a wired network connection.

3. Wi-Fi Network Setup Details

Determine the configuration of the Wi-Fi access point to which you plan to connect. You will need:

- ⚙ SSID (Service Set Identifier)
- ⚙ Password (or Key), see note

- ⚙ Encryption type and method (for example, WPA and TKIP shared-key encryption), see note

Note: If the network to be connected is unsecured, only the SSID (or ESSID) needs to be known.

Procedures for determining these parameters vary widely so you will need to refer to your wireless access point user guide or do online research. The setup described in the following paragraphs assumes your Wi-Fi network broadcasts the SSID.

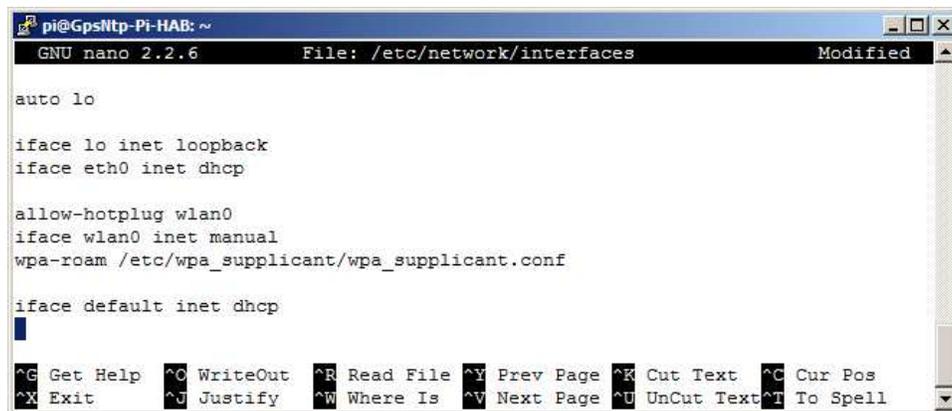
4. Setup W-Fi Configuration

Do not yet plug in the Wi-Fi dongle. Log into the RPi and enter the following:

```
sudo nano /etc/network/interfaces
```

The default settings for the interfaces have changed over time. The details for two scenarios are described below. Use the one that matches your default settings for the network interfaces.

Network interface scenario 1:



```
pi@GpsNtp-Pi-HAB: ~
GNU nano 2.2.6 File: /etc/network/interfaces Modified
auto lo

iface lo inet loopback
iface eth0 inet dhcp

allow-hotplug wlan0
iface wlan0 inet manual
wpa-roam /etc/wpa_supplicant/wpa_supplicant.conf

iface default inet dhcp

^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^K Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell
```

Note the first three lines shown below, but do not change them. These statements form the basic wired network interface configuration in which the RPi uses a dynamically obtained IP address (DHCP) on the eth0 interface:

```
auto lo

iface lo inet loopback
iface eth0 inet dhcp
```

Also note the additional lines shown below. These provide basic WLAN configuration details.

```
allow-hotplug wlan0
iface wlan0 inet manual
wpa-roam /etc/wpa_supplicant/wpa_supplicant.conf
```

These lines must be edited for both secured and unsecured networks. Use the keyboard arrow keys to navigate.

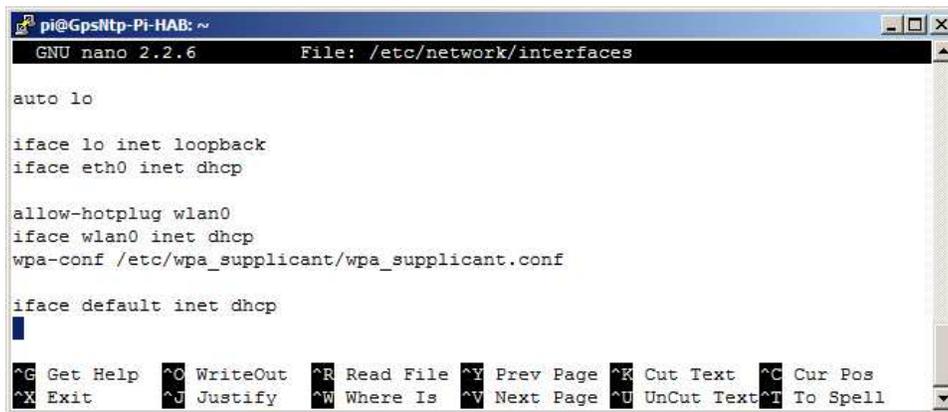
Unsecured network: Change `manual` to `dhcp` in the second line and comment out the third line. Add a fourth line with the ESSID for the unsecured network. When done, the group of lines should look like this:

```
allow-hotplug wlan0
iface wlan0 inet dhcp
# wpa-roam /etc/wpa_supplicant/wpa_supplicant.conf
wireless-essid Your_NETWORK_Name
```

Be sure to replace `Your_NETWORK_Name` with the actual SSID for the unsecured network; do not use quotation marks.

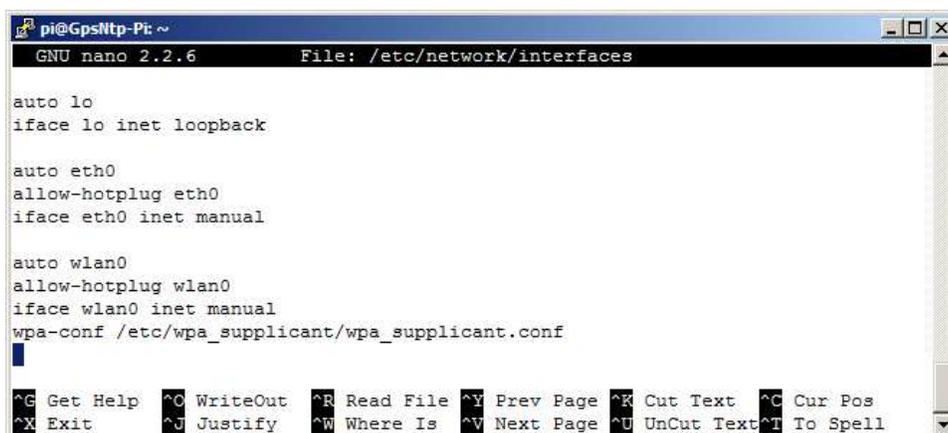
Secured network: Change `manual` to `dhcp` in the second line, and change `wpa-roam` to `wpa-conf` in the third line. When done, the group of lines should look like this:

```
allow-hotplug wlan0
iface wlan0 inet dhcp
wpa-conf /etc/wpa_supplicant/wpa_supplicant.conf
```



When finished editing, type CTRL-X (Exit), Y (yes), Enter to save the file and close nano.

Network interface scenario 2:



Note the first five lines shown below. In these statements the wired interface (eth0) is set to Auto mode. Do not change the lines:

```
auto lo
iface lo inet loopback

auto eth0
allow-hotplug eth0
iface eth0 inet manual
```

Also note the additional lines shown below for the wireless interface (wlan0). These provide basic WLAN configuration details and are similar to [scenario 1](#).

```
auto wlan0
allow-hotplug wlan0
iface wlan0 inet manual
wpa-conf /etc/wpa_supplicant/wpa_supplicant.conf
```

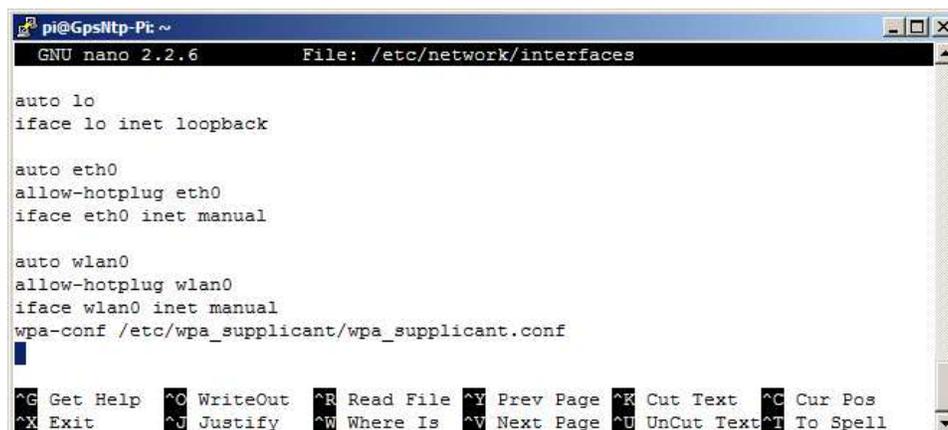
Unsecured network: Delete the first line `auto wlan0`, change `manual` to `dhcp` in the third line and comment out the fourth line. Add a line with the ESSID for the unsecured network. When done, the group of lines should look like this:

```
allow-hotplug wlan0
iface wlan0 inet dhcp
# wpa-conf /etc/wpa_supplicant/wpa_supplicant.conf
wireless-essid Your_NETWORK_Name
```

Be sure to replace `Your_NETWORK_Name` with the actual SSID for the unsecured network; do not use quotation marks. When finished editing, type CTRL-X (Exit), Y (yes), Enter to save the file and close nano.

Secured network: No changes are needed with this scenario. The group of lines should look like this:

```
auto wlan0
allow-hotplug wlan0
iface wlan0 inet manual
wpa-conf /etc/wpa_supplicant/wpa_supplicant.conf
```



```
pi@GpsNtp-Pi ~
GNU nano 2.2.6 File: /etc/network/interfaces

auto lo
iface lo inet loopback

auto eth0
allow-hotplug eth0
iface eth0 inet manual

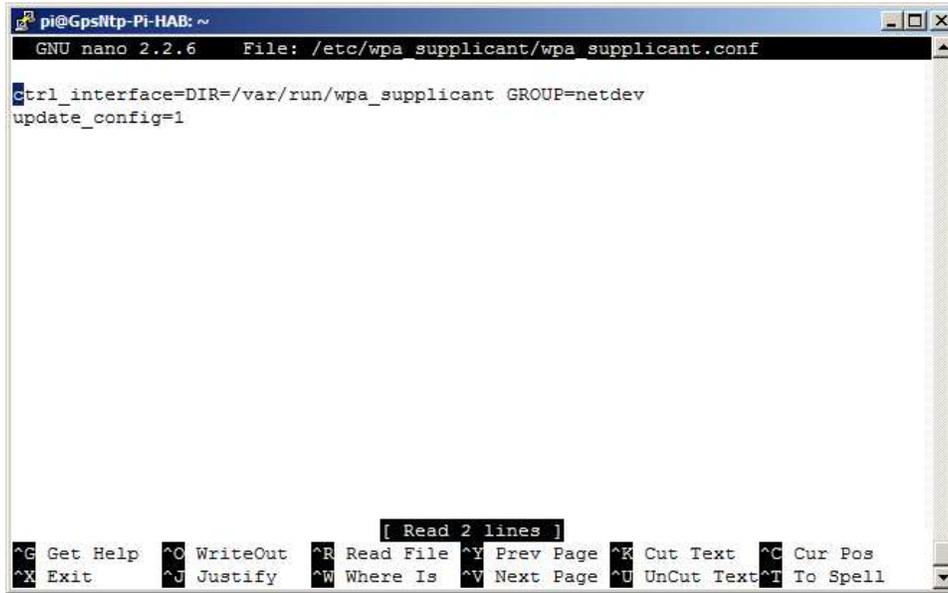
auto wlan0
allow-hotplug wlan0
iface wlan0 inet manual
wpa-conf /etc/wpa_supplicant/wpa_supplicant.conf

^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^K Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell
```

When finished editing, type CTRL-X (Exit), Y (yes), Enter to save the file and close nano. Now, for a secured network, it is necessary to setup the WLAN configuration as described in the following paragraphs.

Secured WLAN configuration: The WLAN configuration details for a secured network are defined by the wpa_supplicant.conf file. At the RPi prompt, enter the following to edit the file:

```
sudo nano /etc/wpa_supplicant/wpa_supplicant.conf
```



Note the following two lines, but do not change them:

```
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
update_config=1
```

Use the keyboard arrow keys to navigate and then add the text indicated below. Be sure to enter the closing brace character } as shown:

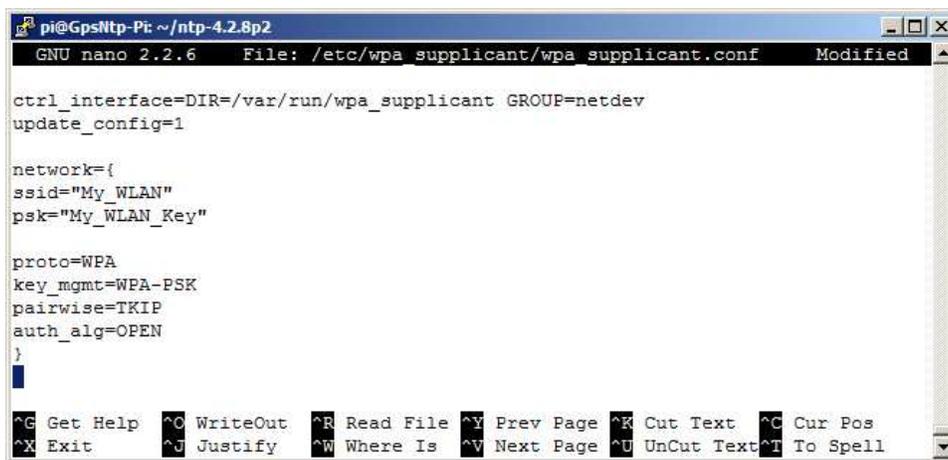
```
# To use a wireless network enter the network details here
# Protocol type can be: RSN (for WP2) and WPA (for WPA1)
# Key management can be: WPA-PSK or WPA-EAP (Pre-Shared or Enterprise)
# Pairwise can be: COMP or TKIP (for WPA2 or WPA1)
# Authorization can be: OPEN for both WPA1/WPA2 (less common are SHARED and LEAP)
# Be sure to include the closing }

network={
ssid="My_WLAN"
psk="My_WLAN_Key"
proto=WPA
key_mgmt=WPA-PSK
pairwise=TKIP
auth_alg=OPEN
}
```

Note that most of text to be entered are comments indicated by the # character at the beginning of the line. These comments cover the most common situations. If additional information is needed, exit the nano editor and at the prompt type `man wpa_supplicant`. This will open the manual for the `wpa_supplicant` file, which will explain all of the options and requirements for its use.

The first two parameters above, `ssid` and `psk`, are the SSID and PASSWORD values, and `proto`, `key_mgmt`, `pairwise` and `auth_alg` are the Encryption type and method that you obtained above from your wireless network. Use the # character to include the comments and change the values shown to match your network details.

When finished, the configuration file should look similar to the screenshot below but it will have your values for each parameter:



```
pi@GpsNtp-Pi: ~/ntp-4.2.8p2
GNU nano 2.2.6 File: /etc/wpa_supplicant/wpa_supplicant.conf Modified
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
update_config=1

network={
ssid="My_WLAN"
psk="My_WLAN_Key"

proto=WPA
key_mgmt=WPA-PSK
pairwise=TKIP
auth_alg=OPEN
}

^G Get Help ^C WriteOut ^R Read File ^Y Prev Page ^K Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell
```

If you have more than one Wi-Fi network, you can add each of them to the `wpa_supplicant.conf` file. The RPi will then connect to the one with the best signal. For a setup with multiple networks, the text lines “`network = { additional network details }`” will need to be determined and specified for each network.

When done editing the file, type CTRL+X (Exit), Y (Yes) and ENTER to save and exit the configuration file.

WLAN USB port power management: To prevent the Realtek RTL8188/8192 WLAN dongle from going to sleep due to power management (from which it will not wakeup without reboot), create a new file called `8192cu.conf`. The type of dongle in your system can be determined as described in the next section. Meanwhile, enter the following:

```
sudo nano /etc/modprobe.d/8192cu.conf
```

When the new file is first opened, it will not have any entries. Add the following two lines:

```
# Disable power management
options 8192cu rtw_power_mgnt=0 rtw_enusbss=0
```

When done the new configuration file should look like this:



```
pi@GpsItP-Pi-HAB: ~
GNU nano 2.2.6 File: /etc/modprobe.d/8192cu.conf
# Disable power management
options 8192cu rtw_power_mgnt=0 rtw_enusbss=0
^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^K Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell
```

When finished editing, type CTRL-X (Exit), Y (yes), Enter to save the new file and close nano.

Now, shutdown the RPi:

```
sudo halt
```

Wait until all LED indicators extinguish on the RPi board except the red power LED. When shutdown is complete, remove power.

5. Install the WLAN Dongle

After shutdown and with power disconnected from the RPi, unplug the Ethernet cable and plug the WLAN dongle into any USB port on the RPi. Place the RPi within line-of-sight and within 3 m of the wireless access point. Connect power to RPi. As it boots, the RPi power LED (red) will turn on and stay on and the Activity LED (green) will flash as the software image is loaded.

This RPi WLAN configuration uses DHCP to request an IP address from the router and will automatically establish a connection. Most WLAN dongles have a status LED (yellow, red or blue) that will begin to flash near the end of the RPi boot cycle. The LED initially will flash at about 1 Hz rate. When it has connected to the wireless access point, the LED will flash irregularly to indicate activity. If the status LED does not light or continues to flash at 1 Hz rate for more than a minute (with no occasional flashes), there is a problem in your setup, the WLAN is out of range or your RPi power supply is inadequate for the additional load of the WLAN dongle.

You will not be able to log into the RPi until you determine the wireless IP address and then setup the SSH client terminal (PuTTY) to use that address. Check your router or use a network scanning tool, for example, SoftPerfect Network Scanner [{NetScan}](#), to find the RPi hostname. It should be the same hostname as the wired network connection but this time it may have a different IP address.

If the RPi fails to appear on the network, you can plug the Ethernet cable back in, log into the wired Ethernet interface and double-check the above steps. You most likely made a typing error. After finding and fixing the error, you must restart the network interface by rebooting the RPi. To reboot enter:

```
sudo reboot
```

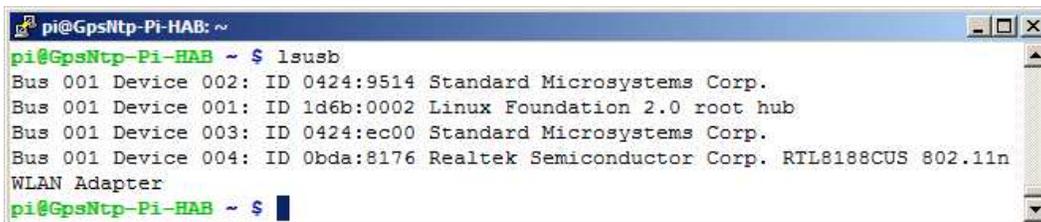
Disconnect the wired Ethernet cable and log into the wireless interface using the wireless IP address. Remember, do not insert or remove the WLAN dongle with power applied to the RPi, but it is okay to remove and install the wired LAN cable with power on.

It is possible to use both the wired and wireless LAN interfaces at the same time; however, It is recommended that one or the other be used and not simultaneously. If wired LAN interface is to be used, remove the WLAN dongle (with RPi power off). If wireless LAN is to be used, remove the wired LAN cable. No changes are required to RPi configuration files.

To determine type of WLAN dongle enter:

```
lsusb
```

A list of USB devices will appear. The Realtek RTL8188CUS is shown last in the list below as Device 004.

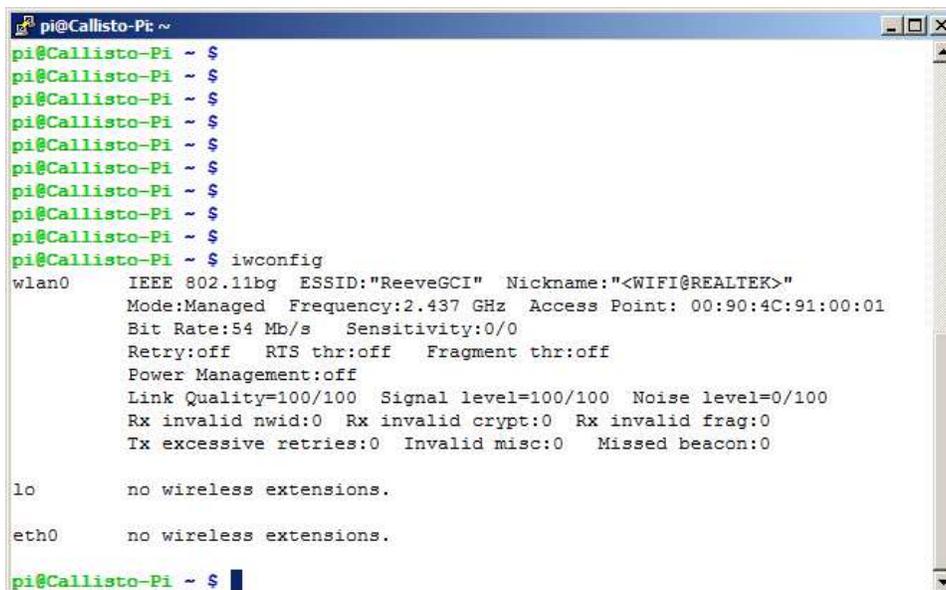


```
pi@GpsNtp-Pi-HAB: ~  
pi@GpsNtp-Pi-HAB ~ $ lsusb  
Bus 001 Device 002: ID 0424:9514 Standard Microsystems Corp.  
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub  
Bus 001 Device 003: ID 0424:ec00 Standard Microsystems Corp.  
Bus 001 Device 004: ID 0bda:8176 Realtek Semiconductor Corp. RTL8188CUS 802.11n  
WLAN Adapter  
pi@GpsNtp-Pi-HAB ~ $
```

6. Check the WLAN

After logging into RPi, you can check the wireless connection quality. At the RPi prompt, enter:

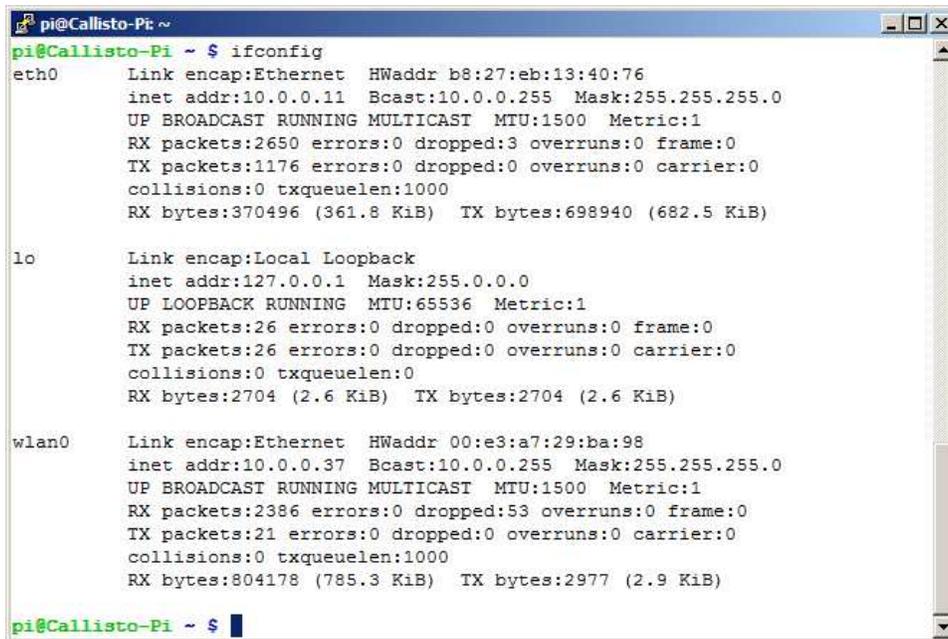
```
iwconfig
```



```
pi@Callisto-Pi ~  
pi@Callisto-Pi ~ $  
pi@Callisto-Pi ~ $ iwconfig  
wlan0 IEEE 802.11bg ESSID:"ReeveGCI" Nickname:"<WIFI@REALTEK>"  
Mode:Managed Frequency:2.437 GHz Access Point: 00:90:4C:91:00:01  
Bit Rate:54 Mb/s Sensitivity:0/0  
Retry:off RTS thr:off Fragment thr:off  
Power Management:off  
Link Quality=100/100 Signal level=100/100 Noise level=0/100  
Rx invalid nwid:0 Rx invalid crypt:0 Rx invalid frag:0  
Tx excessive retries:0 Invalid misc:0 Missed beacon:0  
  
lo no wireless extensions.  
  
eth0 no wireless extensions.  
  
pi@Callisto-Pi ~ $
```

The **wlan0** interface details include the SSID, frequency, bit-rate, link quality, signal level and noise level plus other information about the wireless connection. To see packet information and IP addresses for all connected network interfaces enter (in the following example, both the wired and wireless connections are active):

ifconfig



```
pi@Callisto-Pi ~ $ ifconfig
eth0      Link encap:Ethernet  HWaddr b8:27:eb:13:40:76
          inet addr:10.0.0.11  Bcast:10.0.0.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2650 errors:0 dropped:3 overruns:0 frame:0
          TX packets:1176 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:370496 (361.8 KiB)  TX bytes:698940 (682.5 KiB)

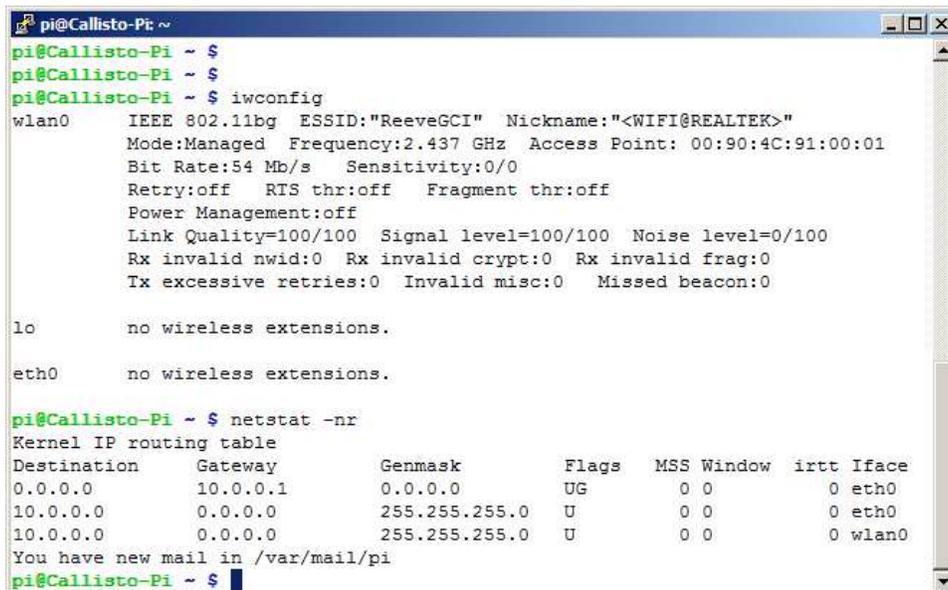
lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:26 errors:0 dropped:0 overruns:0 frame:0
          TX packets:26 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:2704 (2.6 KiB)  TX bytes:2704 (2.6 KiB)

wlan0     Link encap:Ethernet  HWaddr 00:e3:a7:29:ba:98
          inet addr:10.0.0.37  Bcast:10.0.0.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2386 errors:0 dropped:53 overruns:0 frame:0
          TX packets:21 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:804178 (785.3 KiB)  TX bytes:2977 (2.9 KiB)

pi@Callisto-Pi ~ $
```

You also can obtain information about your network by entering:

netstat -nr



```
pi@Callisto-Pi ~ $
pi@Callisto-Pi ~ $
pi@Callisto-Pi ~ $ iwconfig
wlan0     IEEE 802.11bg  ESSID:"ReeveGCI"  Nickname:"<WIFI@REALTEK>"
          Mode:Managed  Frequency:2.437 GHz  Access Point: 00:90:4C:91:00:01
          Bit Rate:54 Mb/s   Sensitivity:0/0
          Retry:off   RTS thr:off   Fragment thr:off
          Power Management:off
          Link Quality=100/100  Signal level=100/100  Noise level=0/100
          Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
          Tx excessive retries:0  Invalid misc:0  Missed beacon:0

lo        no wireless extensions.

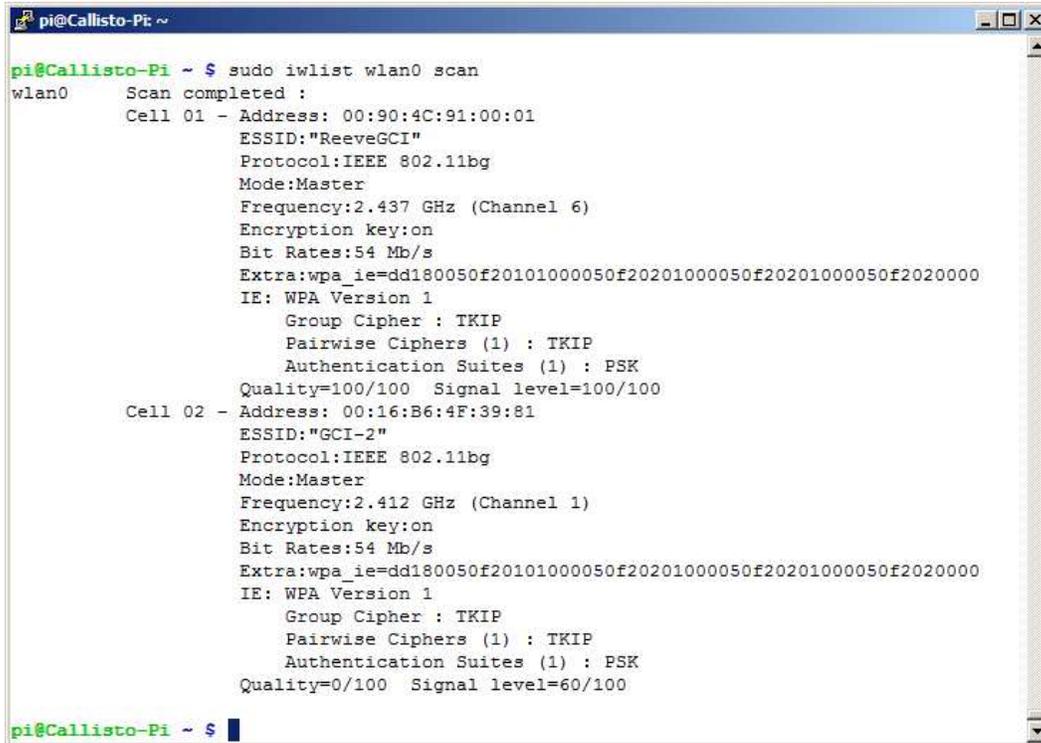
eth0     no wireless extensions.

pi@Callisto-Pi ~ $ netstat -nr
Kernel IP routing table
Destination Gateway Genmask Flags MSS Window irtt Iface
0.0.0.0    10.0.0.1 0.0.0.0 UG 0 0 0 eth0
10.0.0.0   0.0.0.0 255.255.255.0 U 0 0 0 eth0
10.0.0.0   0.0.0.0 255.255.255.0 U 0 0 0 wlan0
You have new mail in /var/mail/pi
pi@Callisto-Pi ~ $
```

At the bottom of the window is a routing table. In this example, the wired Ethernet cable was left connected so it shows both the wired Ethernet (**eth0**) and wireless LAN connection (**wlan0**).

The following commands also can be used to check the quality of the wireless connection:

```
sudo iwlist wlan0 scan
```



```
pi@Callisto-Pi ~ $ sudo iwlist wlan0 scan
wlan0    Scan completed :
         Cell 01 - Address: 00:90:4C:91:00:01
                   ESSID:"ReeveGCI"
                   Protocol:IEEE 802.11bg
                   Mode:Master
                   Frequency:2.437 GHz (Channel 6)
                   Encryption key:on
                   Bit Rates:54 Mb/s
                   Extra:wpa_ie=dd180050f20101000050f20201000050f20201000050f2020000
                   IE: WPA Version 1
                       Group Cipher : TKIP
                       Pairwise Ciphers (1) : TKIP
                       Authentication Suites (1) : PSK
                   Quality=100/100  Signal level=100/100
         Cell 02 - Address: 00:16:B6:4F:39:81
                   ESSID:"GCI-2"
                   Protocol:IEEE 802.11bg
                   Mode:Master
                   Frequency:2.412 GHz (Channel 1)
                   Encryption key:on
                   Bit Rates:54 Mb/s
                   Extra:wpa_ie=dd180050f20101000050f20201000050f20201000050f2020000
                   IE: WPA Version 1
                       Group Cipher : TKIP
                       Pairwise Ciphers (1) : TKIP
                       Authentication Suites (1) : PSK
                   Quality=0/100  Signal level=60/100

pi@Callisto-Pi ~ $
```

7. Disable Built-In WLAN in Raspberry Pi B Model 3

The built-in WLAN (WiFi) on the RPi3 can be unstable and unreliable and will not work at all if the RPi3 is placed in a metal enclosure. For these reasons, it may be desirable to disable the wireless chip. At the command line prompt, enter

```
sudo nano /etc/modprobe.d/disable_rpi3_wifi_bt.conf
```

If the file already contains the text below, it may be commented out with the hash # character. If so, remove the # so the text appears as indicated below. If the file is empty, enter the text. These lines disable both the internal WiFi and BlueTooth functions. If only the WiFi is to be disabled, do not enter the last three lines:

```
## Disable WiFi
blacklist brcmfmac
blacklist brcmutil
## Disable BlueTooth
blacklist btbcm
blacklist hci_uart
```

To later reenable the onboard wireless chip, open the file in the editor and place the # character before the lines.

8. Web Links

{NetScan} <https://www.softperfect.com/products/networkscanner/>

Nano Editor

Use arrow keys to move the cursor. Move cursor to beginning of text to be copied or cut.

To select text, ALT-a and then use arrow keys

To copy selected text, ALT-^

To cut selected text, CTRL-k

To paste selected text, CTRL-u

Document information

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0.1 (Cleaned up, removed references to Callisto-Pi, 17 Feb 2015)
0.2 (WLAN query and corrected WLAN supplicant, 05 Mar 2015)
0.3 (Updated power requirements, 11 Mar 2015)
0.4 (Added unsecured network setup and corrected supplicant, 21 Jun 2015)
1.0 (Distribution, 21 Jun 2015)
1.1 (Changed sect. 4 for current defaults, 12 Oct 2015)
1.2 (Added disable RPi3 onboard wireless, 13 Aug 2016)