Setting up a Raspberry Pi as a WiFi access point

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Guide Contents

Overview

Would you like to use your Pi as a WiFi router? Or maybe have it as a special filtering access point? Setting up a Pi as an access point (AP) is a bit more advanced than using it as a client, but its still only a half hour of typing to configure. If you want to, this tutorial will make it so the Pi broadcasts a WiFi service and then routes internet traffic to an Ethernet cable. Since its all Linux you can go in and update or configure it however you like.

I used the following pages as a guide to create this tutorial,**please note** many of them will not work completely, but check them out if you are interested!

- http://qcktech.blogspot.com/2012/08/raspberry-pi-as-router.html (http://adafru.it/cfU)
- http://itsacleanmachine.blogspot.com/2013/02/wifi-access-point-with-raspberry-pi.html (http://adafru.it/cfV)
- http://esrlabs.com/android-transporter-for-the-nexus-7-and-the-raspberry-

pi/ (http://adafru.it/cfW)
- http://elinux.org/RPI-Wireless-Hotspot
- http://blog.mxard.com/persistent-iptables-on-raspberry-pi-raspbian (http://adafru.it/qmd)

Currently tested working on Raspbian only, with Jessie and up to Raspberry Pi 3

What you'll need

You'll need a few things to run this tutorial:

- Raspberry Pi (http://adafru.it/1914)- Ethernet is required
- Ethernet cable (http://adafru.it/730)
- WiFi adapter (http://adafru.it/814) **- Not all WiFi adapters work, we know for sure it works with the ones in the Adafruit shop!**
- SD Card (4GB or greater) with Raspbian on it. You can either DIY it or buy a ready-made Raspbian card (http://adafru.it/1121)
- Power supply for your Pi & a Micro USB cable
- USB Console cable (optional) - this makes it a little easier to debug the system (http://adafru.it/954)
- Case for your Pi (optional) (http://adafru.it/2258)
- A SD or MicroSD card reader (http://adafru.it/939) (optional)

Our Pi starter pack (http://adafru.it/qma) will be all you need and even comes with more fun stuff you can play with

Preparation

This tutorial assumes you have your Pi mostly set up and ready to go.

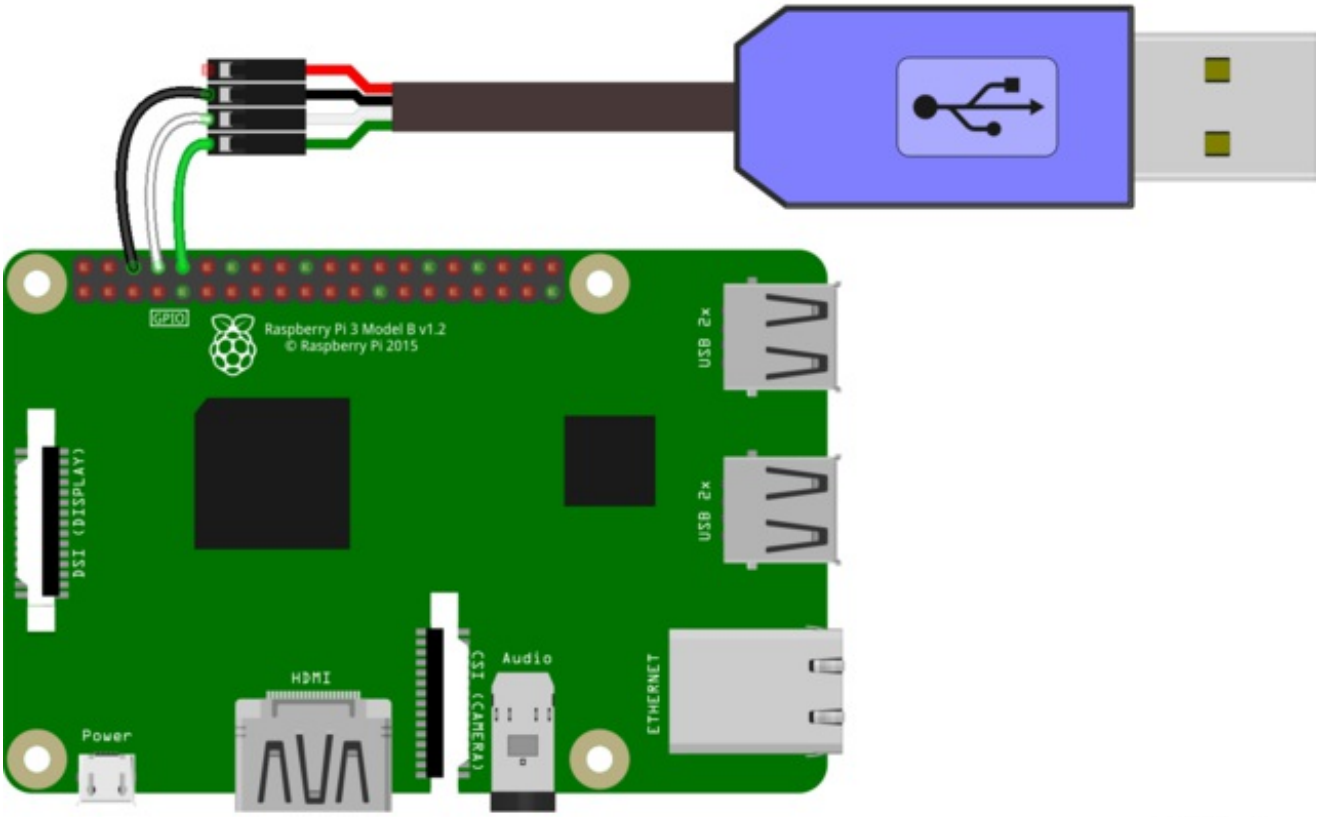
Please follow the tutorials in order to

1. Install the OS onto your SD card (http://adafru.it/aWq)
2. Boot the Pi and configure (http://adafru.it/aUa)
   Don't forget to change the default password for the 'pi' acccount!
3. Set up and test the Ethernet and Wifi connection (http://adafru.it/aUB)
4. Connect with a USB console cable (optional)
   (http://adafru.it/aUA)

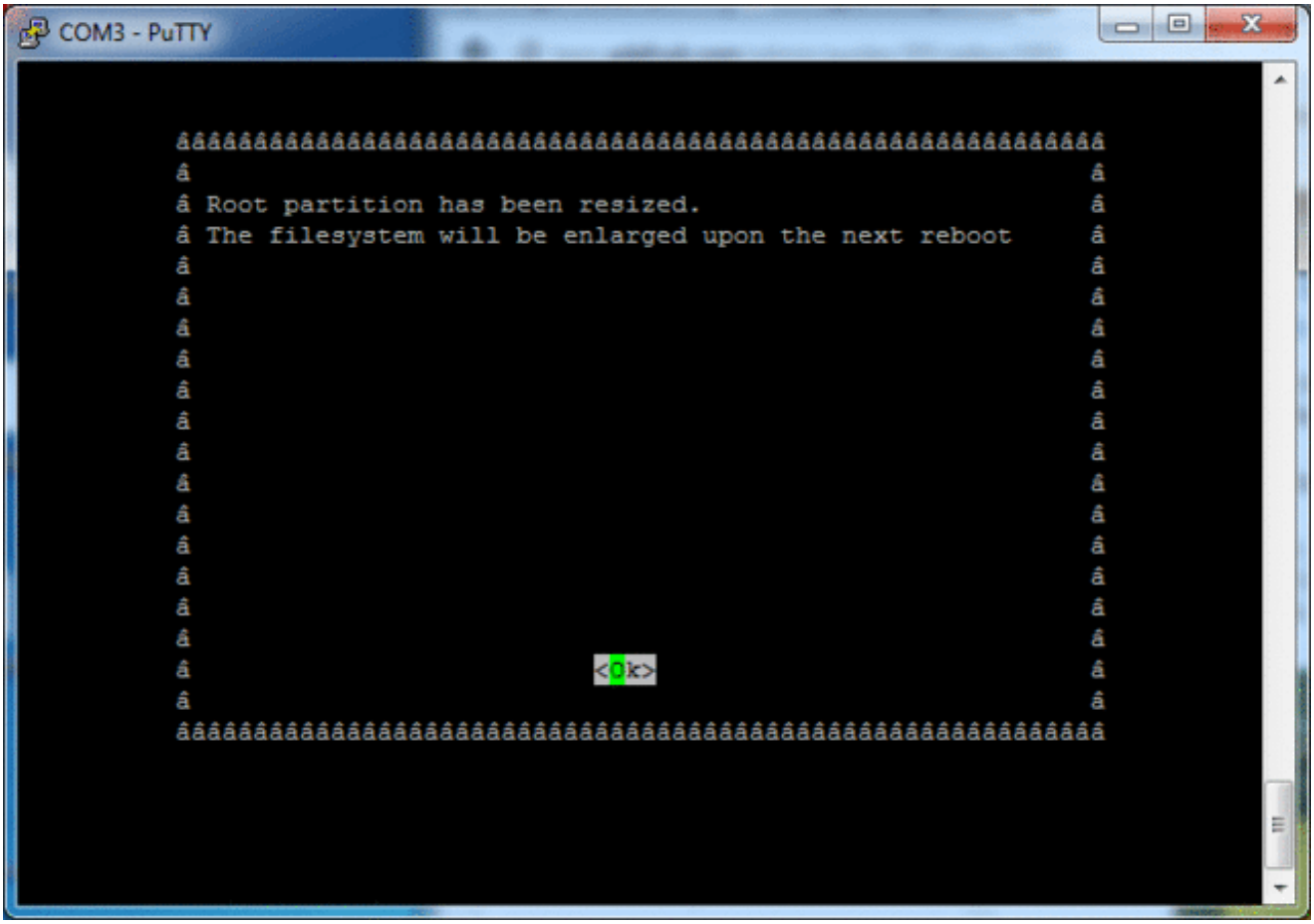
When done you should have a Pi that is booting Raspbian, you can connect to with a USB console cable and log into the Pi via the command line interface.

It is possible to do this tutorial via **ssh** on the Ethernet port **or** using a console cable.

If using a console cable, even though the diagram on the last step shows powering the Pi via the USB console cable (red wire) we suggest not connecting the red wire and instead powering from the wall adapter. Keep the black, white and green cables connected as is.

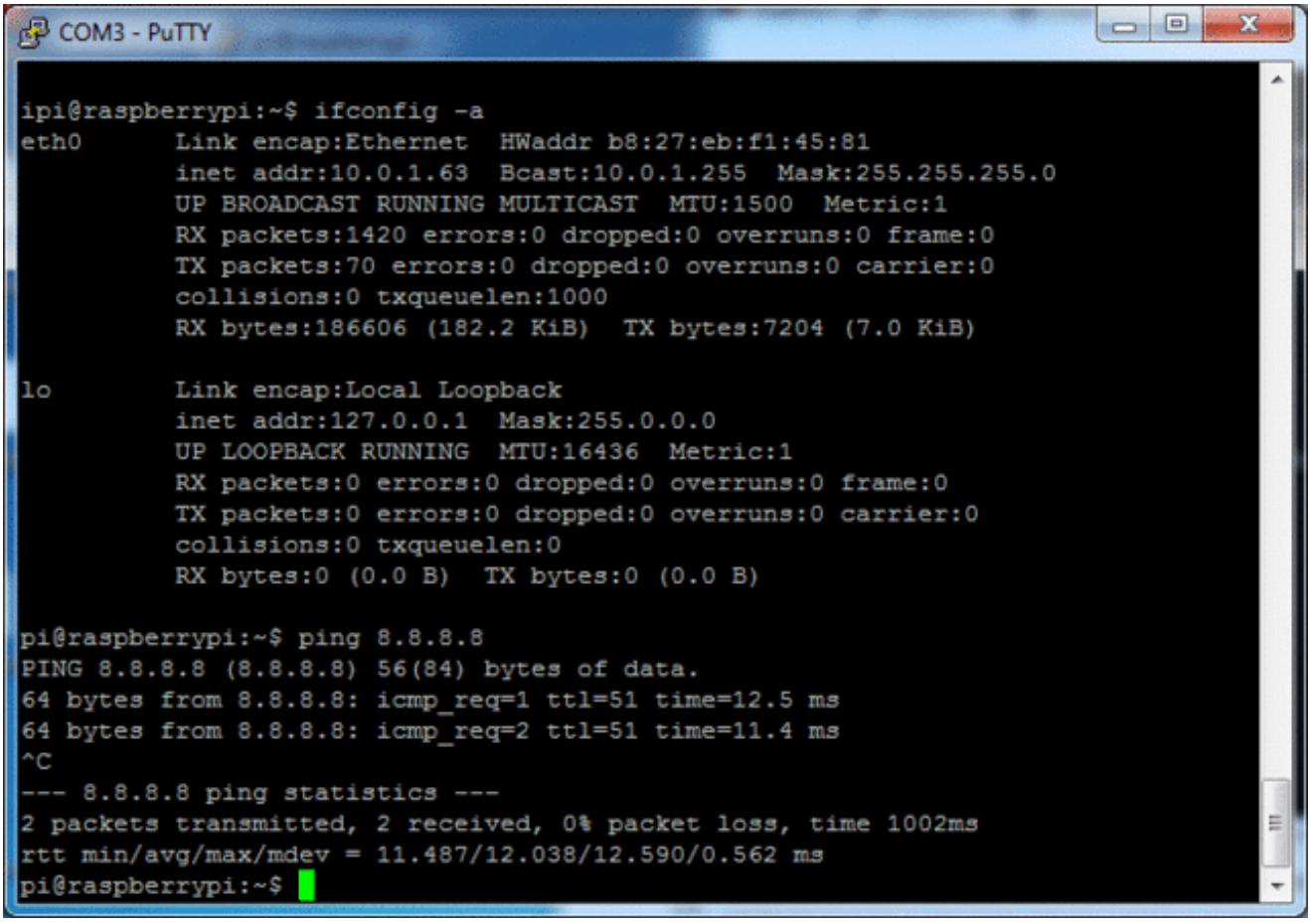


Don't forget to expand the SD card, or you may run out of space!


COM3 - PuTTY
Root partition has been resized.
The filesystem will be enlarged upon the next reboot
<Ok>

Check Ethernet & Wifi

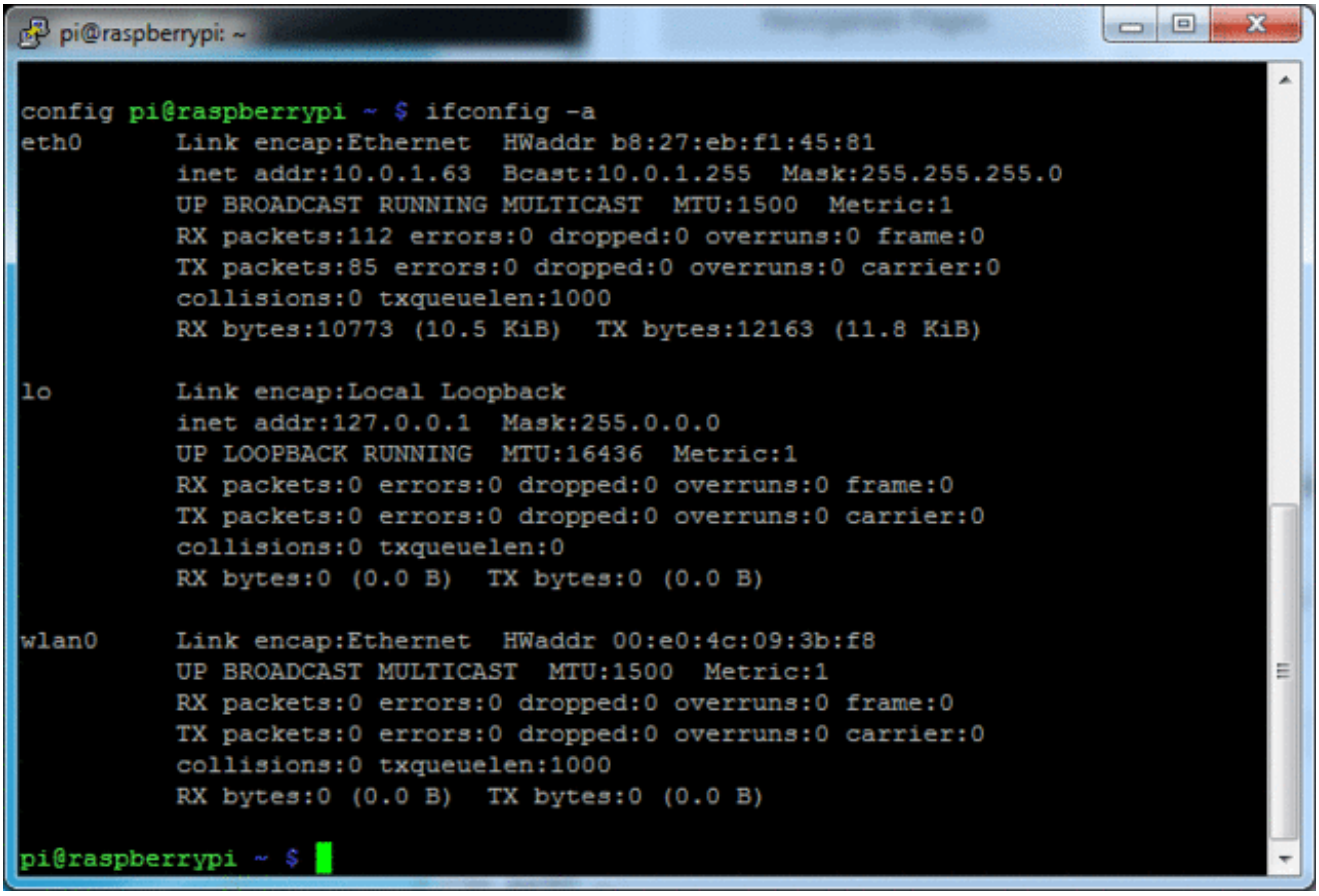
Before continuing make sure the Ethernet cable is connected in and you can **ping** out from the Pi: ping 8.8.8.8



You will also want to set up your WiFi dongle. run **sudo shutdown -h now** and then plug in the WiFi module when the Pi is off so you don't cause a power surge.

If you have a Pi 3, or any other Pi with built in WiFi, an external WiFi adapter is not required but you *can* use one if you need a bigger/external antenna

When it comes back up check with **ifconfig -a** that you see **wlan0** - the WiFi module.

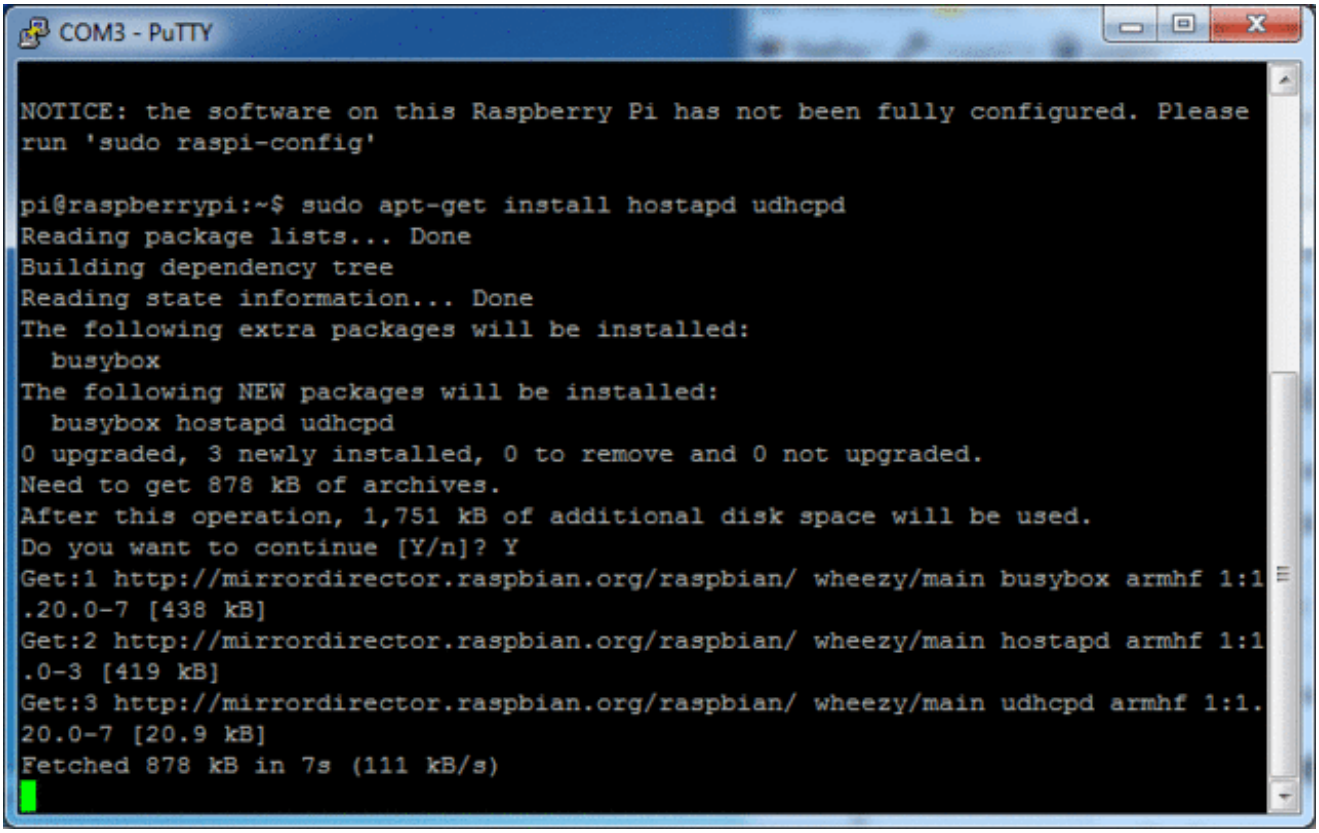

pi@raspberrypi: ~
config pi@raspberrypi ~ $ ifconfig -a
eth0 Link encap:Ethernet HWaddr b8:27:eb:f1:45:81
inet addr:10.0.1.63 Bcast:10.0.1.255 Mask:255.255.255.0
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:112 errors:0 dropped:0 overruns:0 frame:0
TX packets:85 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:10773 (10.5 KiB) TX bytes:12163 (11.8 KiB)
lo Link encap:Local Loopback
inet addr:127.0.0.1 Mask:255.0.0.0
UP LOOPBACK RUNNING MTU:16436 Metric:1
RX packets:0 errors:0 dropped:0 overruns:0 frame:0
TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:0
RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)
wlan0 Link encap:Ethernet HWaddr 00:e0:4c:09:3b:f8
UP BROADCAST MULTICAST MTU:1500 Metric:1
RX packets:0 errors:0 dropped:0 overruns:0 frame:0
TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)
pi@raspberrypi ~ $

Install software

Next up we install the software onto the Pi that will act as the 'hostap' (host access point)
You need internet access for this step so make sure that Ethernet connection is up!

```
sudo apt-get update
sudo apt-get install hostapd isc-dhcp-server
```

(You may need to **sudo apt-get update** if the Pi can't seem to get to the apt-get repositories)

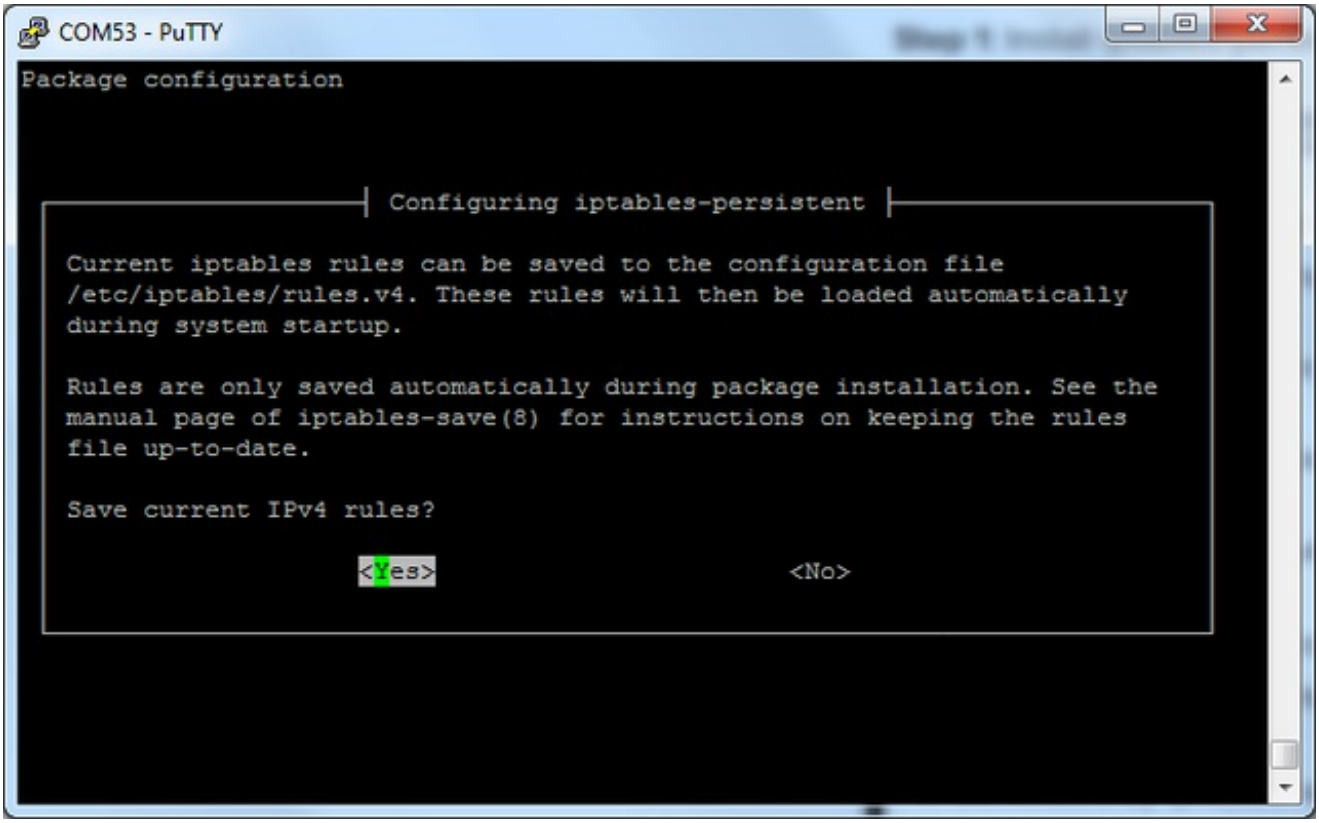


(text above shows udhcpd but that doesnt work as well as isc-dhcp-server, still, the output should look similar)

Also install a nice iptables manager with

```
sudo apt-get install iptables-persistent
```

You'll get two 'config' screens, say **Yes** to both



Set up DHCP server

Next we will edit **/etc/dhcp/dhcpd.conf**, a file that sets up our DHCP server - this allows wifi connections to automatically get IP addresses, DNS, etc.

Run this command to edit the file

```
sudo nano /etc/dhcp/dhcpd.conf
```

Find the lines that say

```
option domain-name "example.org";
option domain-name-servers ns1.example.org, ns2.example.org;
```

and change them to add a # in the beginning so they say

```
#option domain-name "example.org";
#option domain-name-servers ns1.example.org, ns2.example.org;
```

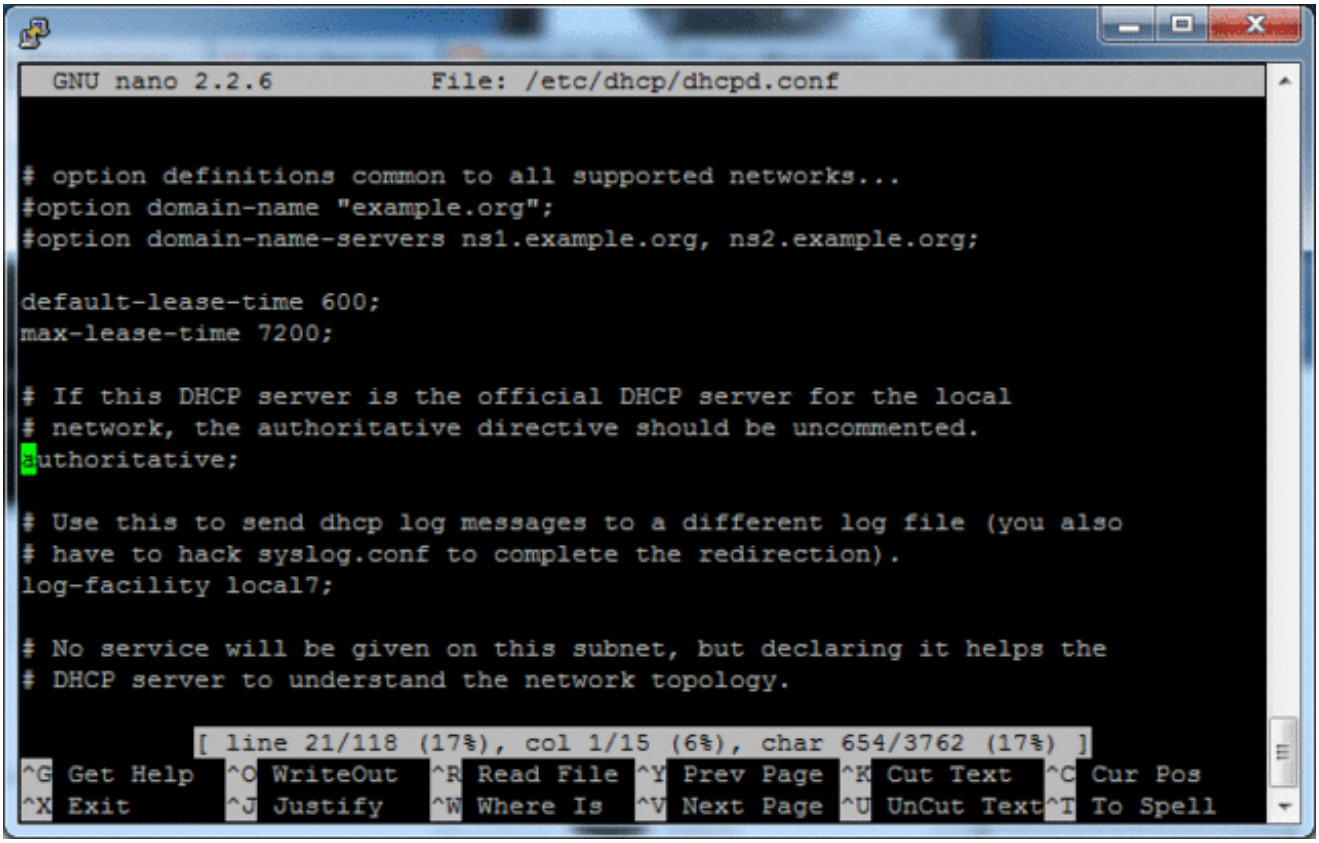
Find the lines that say

```
# If this DHCP server is the official DHCP server for the local
# network, the authoritative directive should be uncommented.
```

#authoritative;

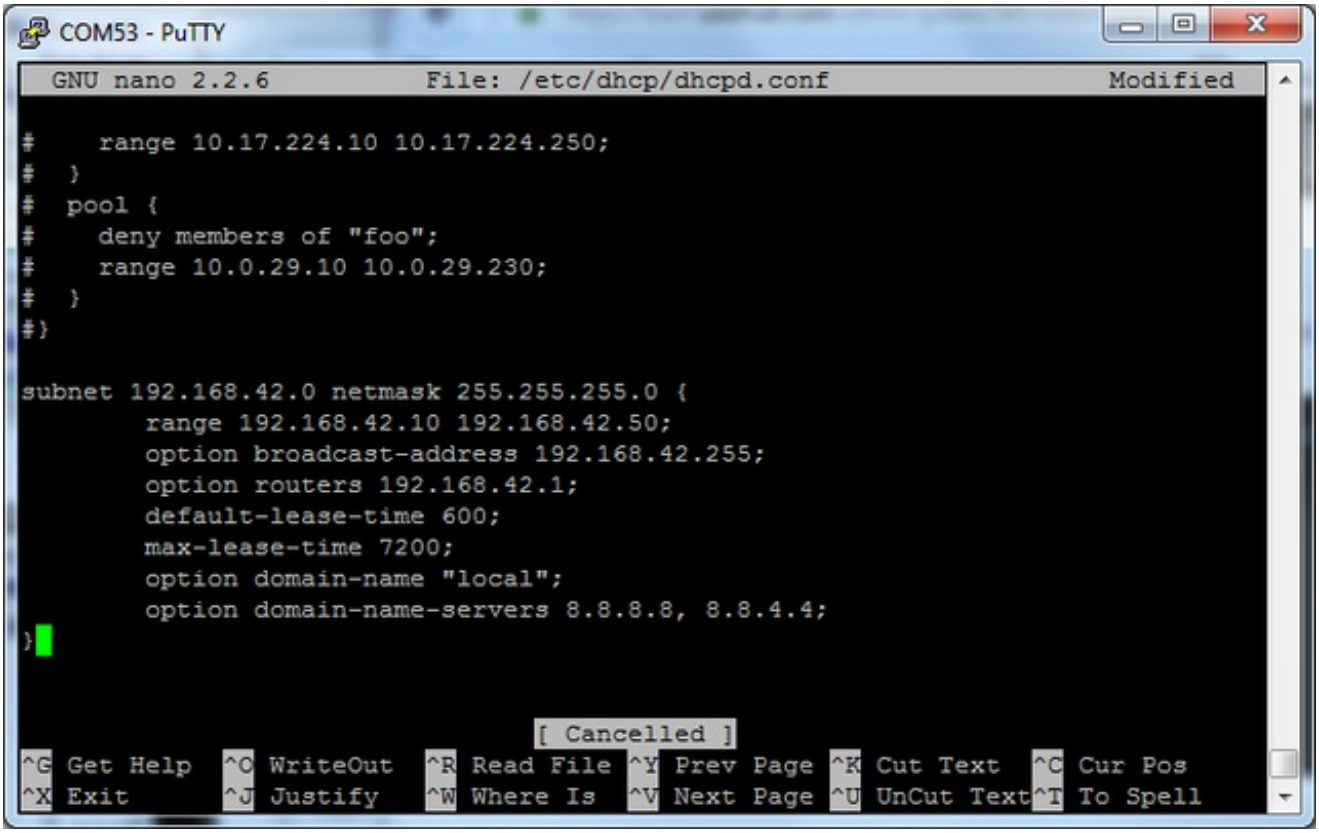
and remove the # so it says

If this DHCP server is the official DHCP server for the local
network, the authoritative directive should be uncommented.
authoritative;



Then scroll down to the bottom and add the following lines

```
subnet 192.168.42.0 netmask 255.255.255.0 {
 range 192.168.42.10 192.168.42.50;
 option broadcast-address 192.168.42.255;
 option routers 192.168.42.1;
 default-lease-time 600;
 max-lease-time 7200;
 option domain-name "local";
 option domain-name-servers 8.8.8.8, 8.8.4.4;
}
```



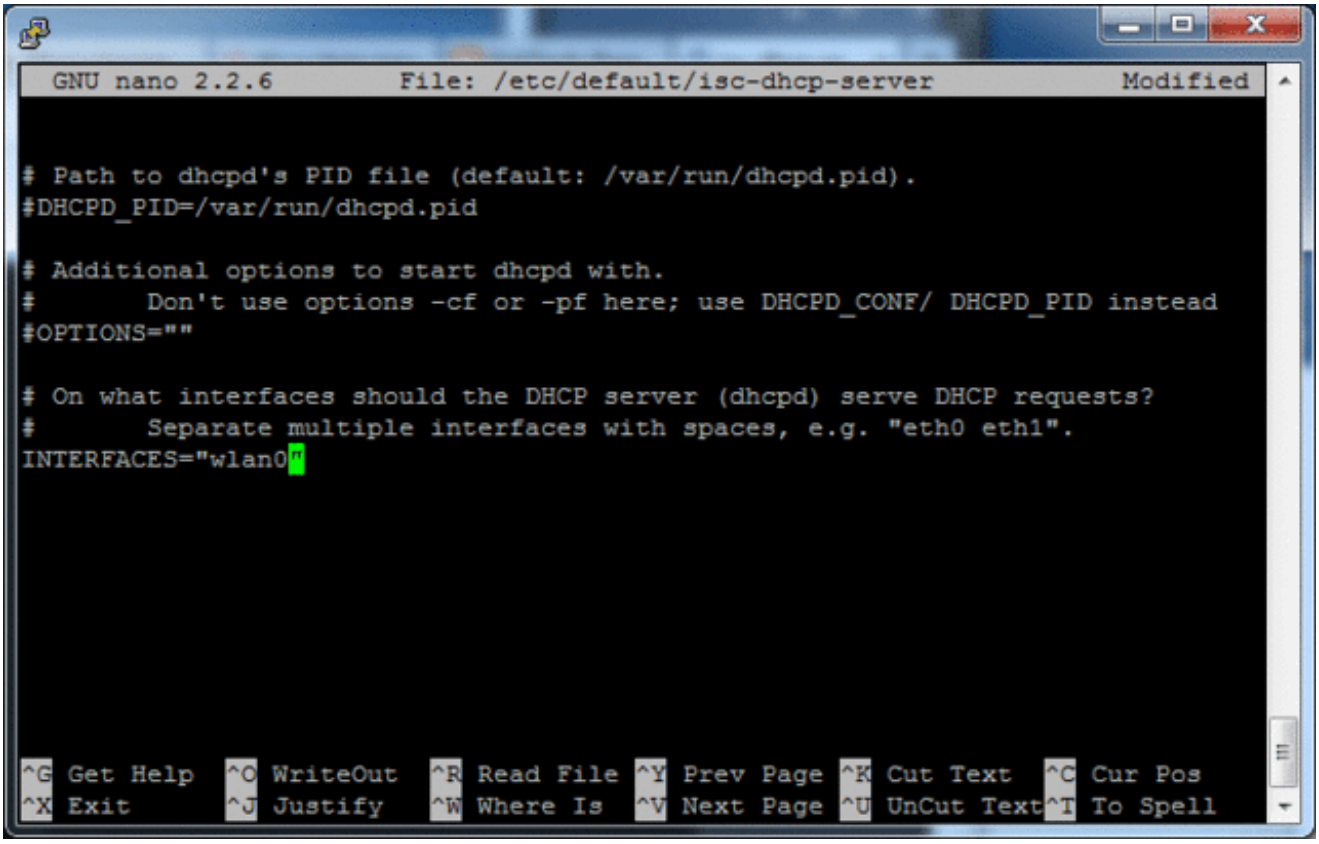
Save the file by typing in **Control-X** then **Y** then **return**

Run

```
sudo nano /etc/default/isc-dhcp-server
```

and scroll down to **INTERFACES=""** and update it to say **INTERFACES="wlan0"**

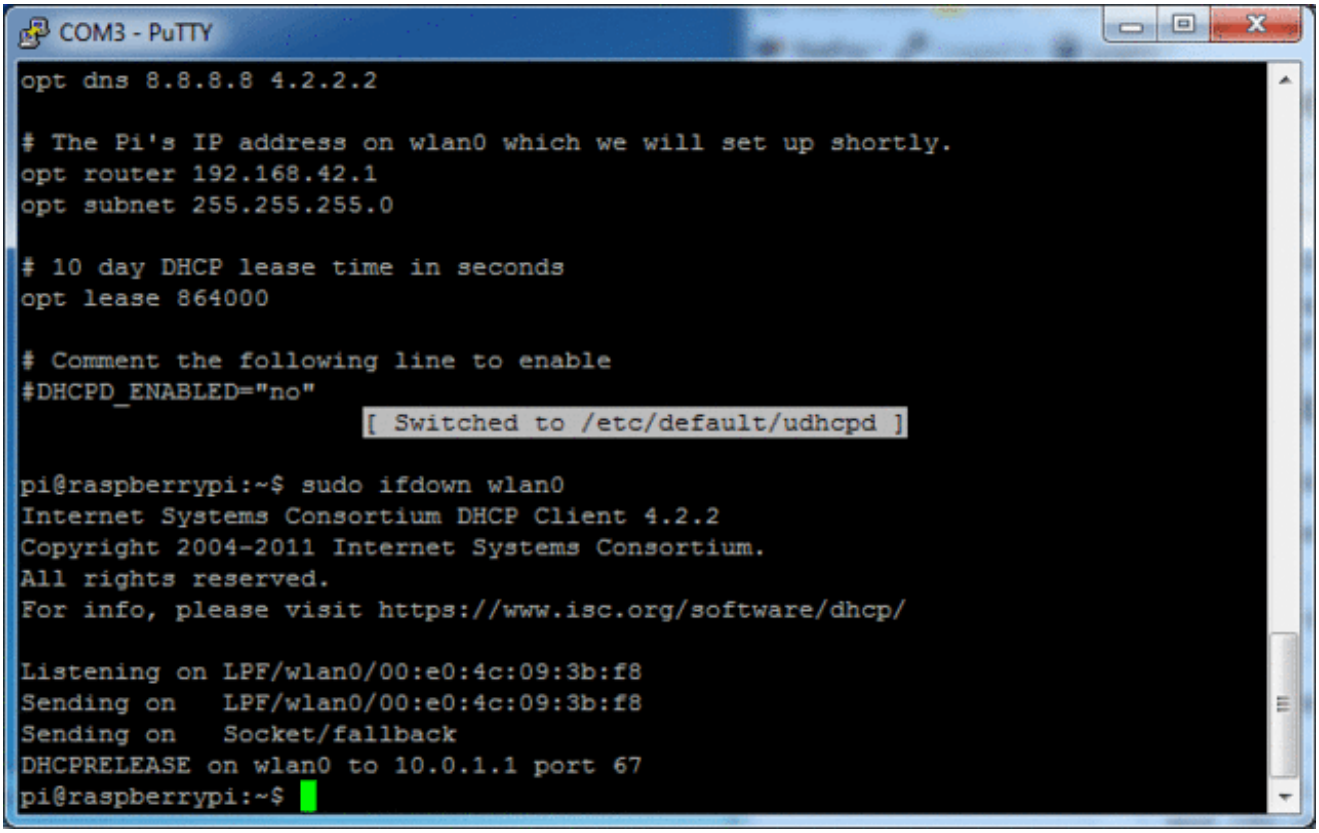
Or whatever the name of your wifi adapter is!



close and save the file

Set up wlan0 for static IP

If you happen to have wlan0 active because you set it up, run **sudo ifdown wlan0**
There's no harm in running it if you're not sure



Next we will set up the**wlan0** connection to be static and incoming. Run`sudo nano /etc/network/interfaces` to edit the file

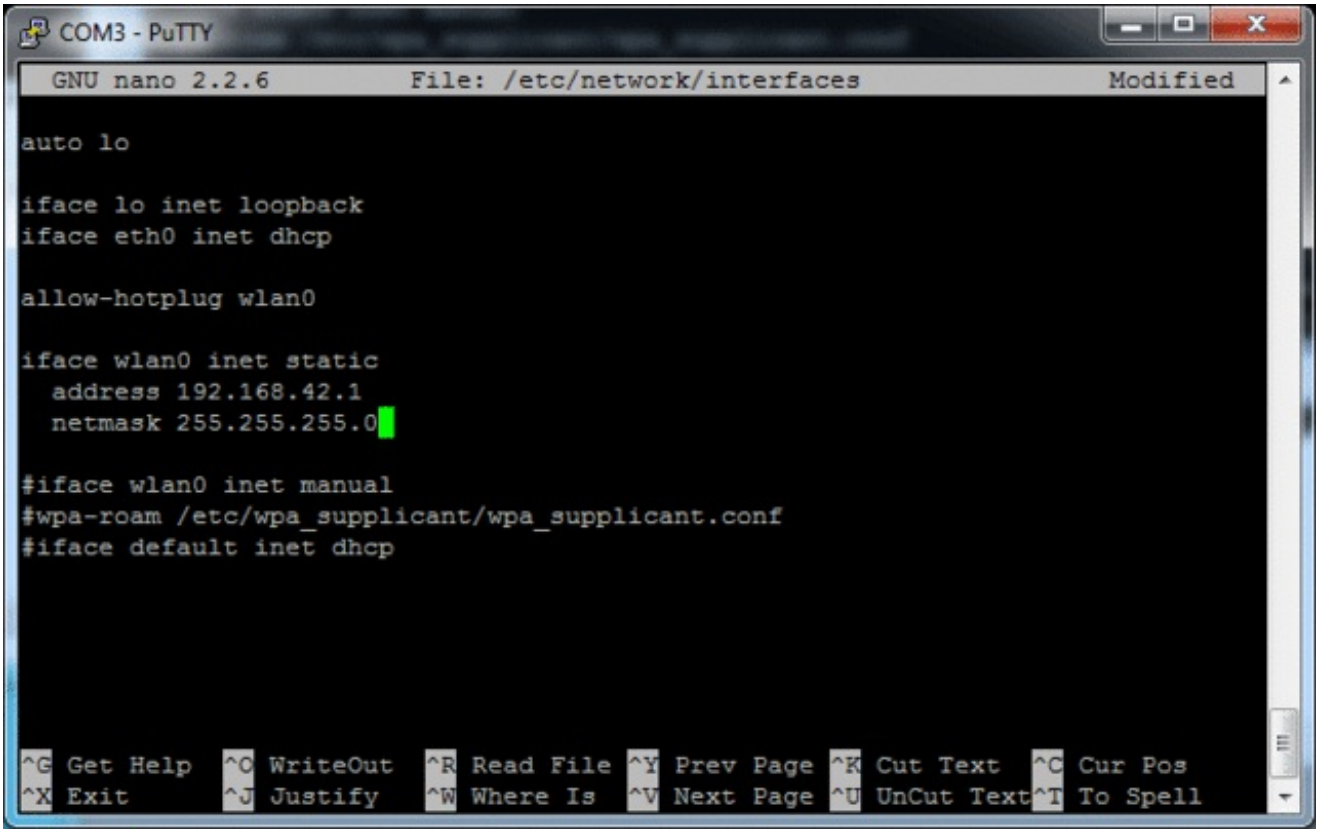
Find the line **auto wlan0** and add a **#** in front of the line, and in front of every line afterwards. If you don't have that line, just make sure it looks like the screenshot below in the end! Basically just remove any old **wlan0** configuration settings, we'll be changing them up

Depending on your existing setup/distribution there might be more or less text and it may vary a little bit

Add the lines

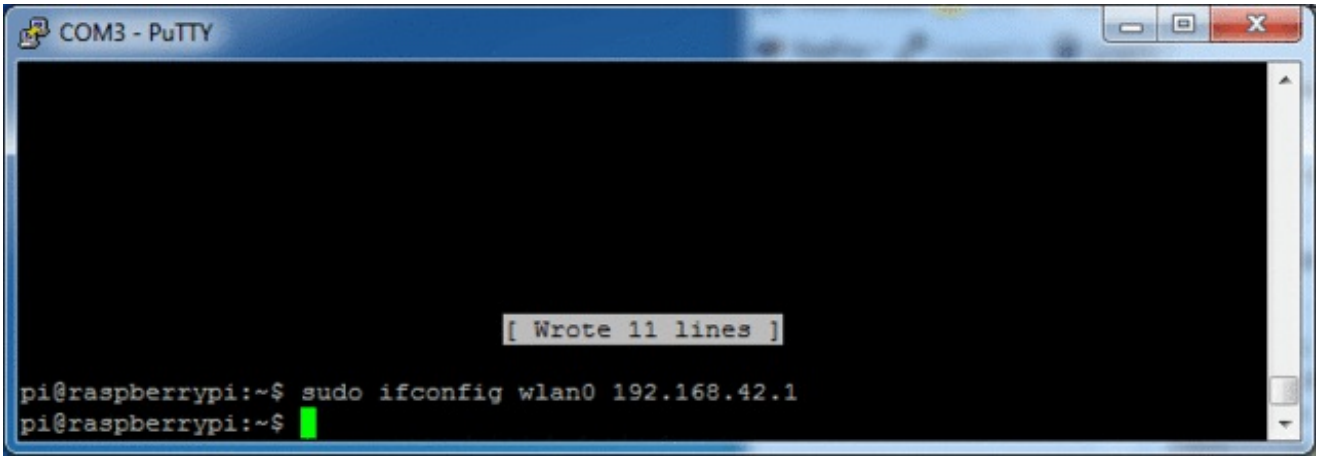
```
iface wlan0 inet static
  address 192.168.42.1
  netmask 255.255.255.0
```

After **allow-hotplug wlan0** - see below for an example of what it should look like. Any other lines afterwards should have a **#** in front to disable them



Save the file (Control-X Y)

Assign a static IP address to the wifi adapter by running
sudo ifconfig wlan0 192.168.42.1



Configure Access Point

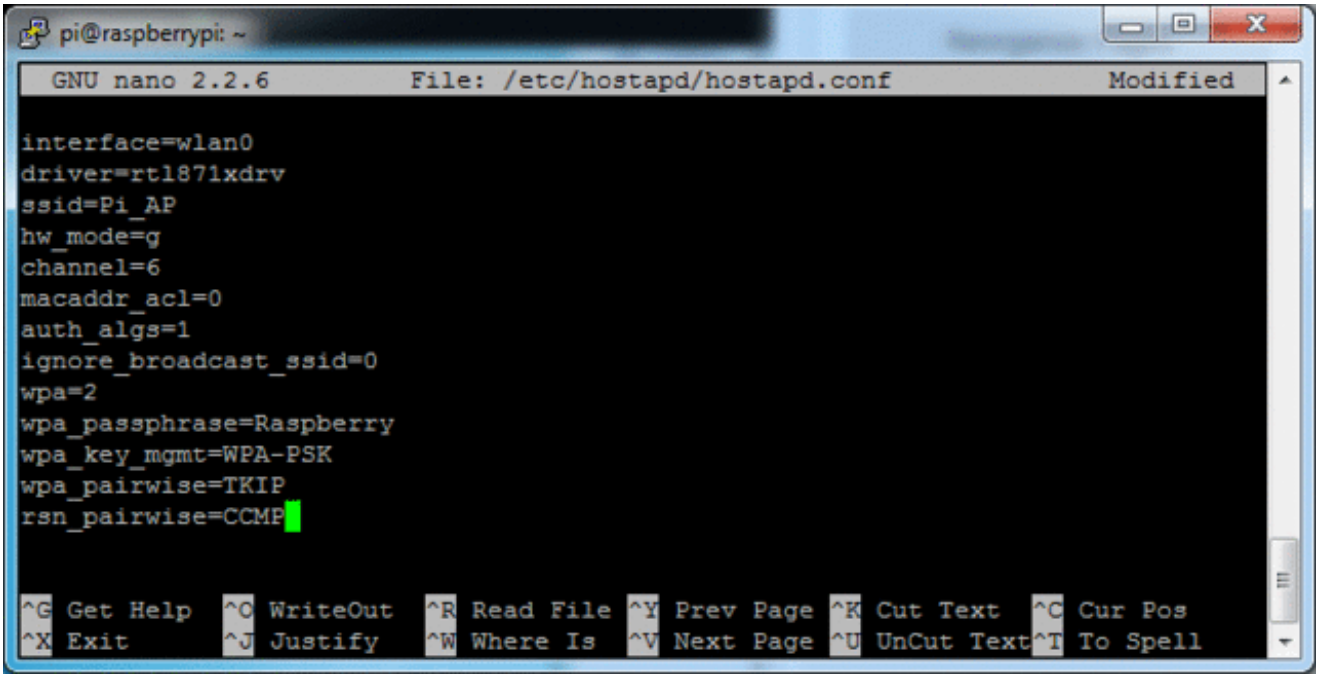
Now we can configure the access point details. We will set up a password-protected network so only people with the password can connect.

Create a new file by running `sudo nano /etc/hostapd/hostapd.conf`

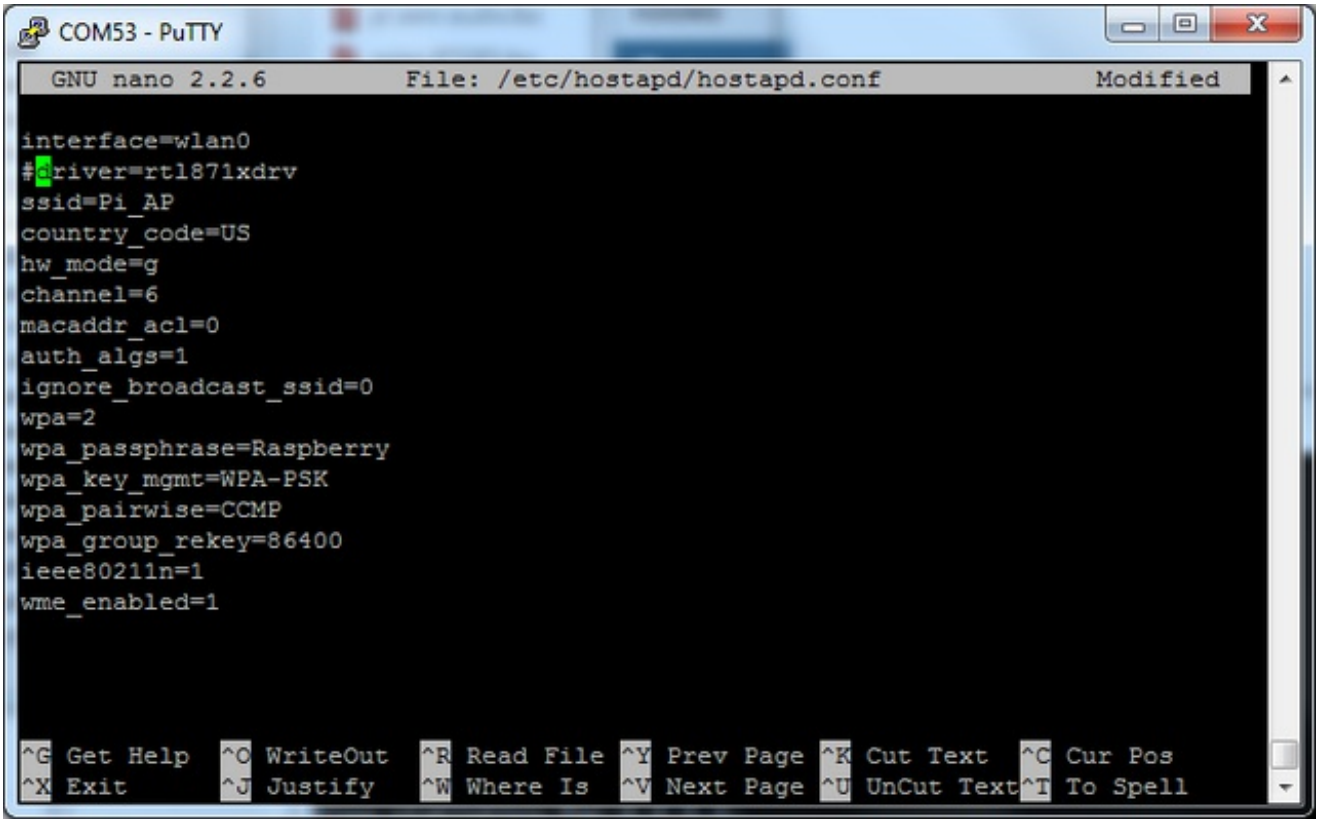
Paste the following in, you can change the text after **ssid=** to another name, that will be the network broadcast name. The password can be changed with the text after **wpa_passphrase=**

```
interface=wlan0
driver=rtl871xdrv
ssid=Pi_AP
country_code=US
hw_mode=g
channel=6
macaddr_acl=0
auth_algs=1
ignore_broadcast_ssid=0
wpa=2
wpa_passphrase=Raspberry
wpa_key_mgmt=WPA-PSK
wpa_pairwise=CCMP
wpa_group_rekey=86400
ieee80211n=1
wme_enabled=1
```

If you are not using the Adafruit wifi adapters, you may have to change the **driver=rtl871xdrv** to say **driver=nl80211** or something



If you are using the Raspberry Pi 3's internal WiFi adapter, comment out the `driver=rtl871xdrv` line altogether:

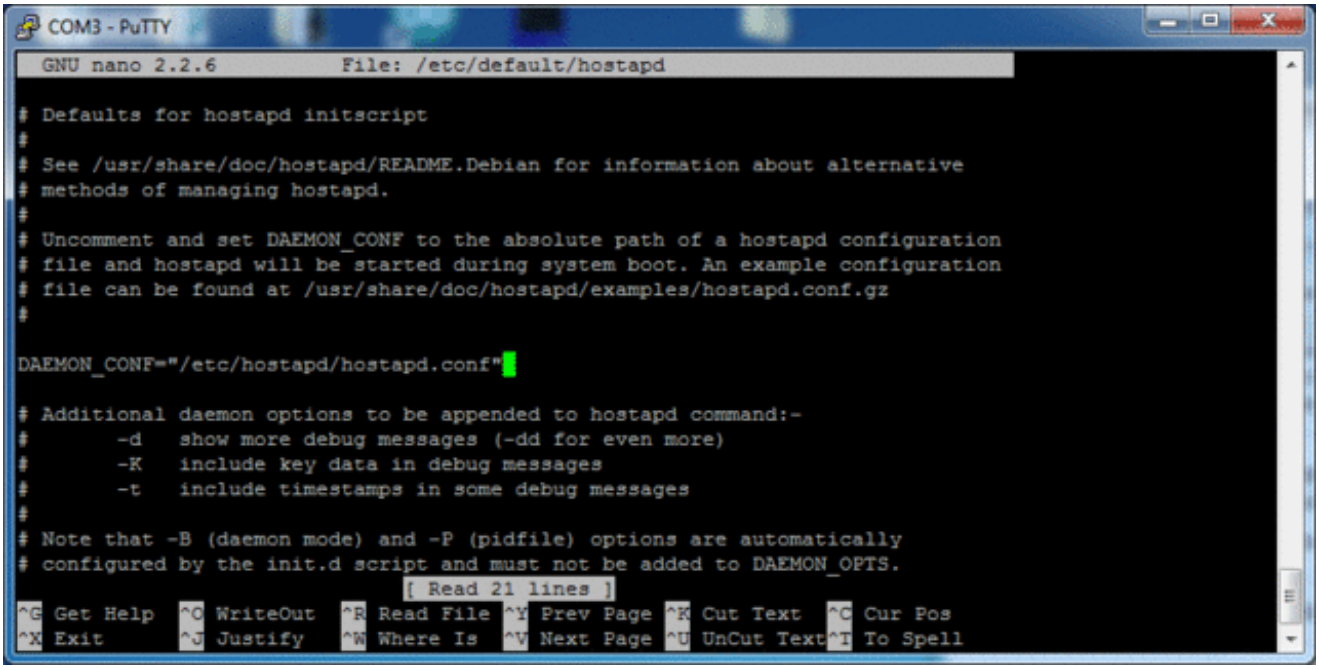


Save as usual. Make sure each line has no extra spaces or tabs at the end or beginning - this file is pretty picky!

Now we will tell the Pi where to find this configuration file. Run **sudo nano /etc/default/hostapd**

Find the line **#DAEMON_CONF=""** and edit it so it says **DAEMON_CONF="/etc/hostapd/hostapd.conf"**
Don't forget to remove the **#** in front to activate it!

Then save the file

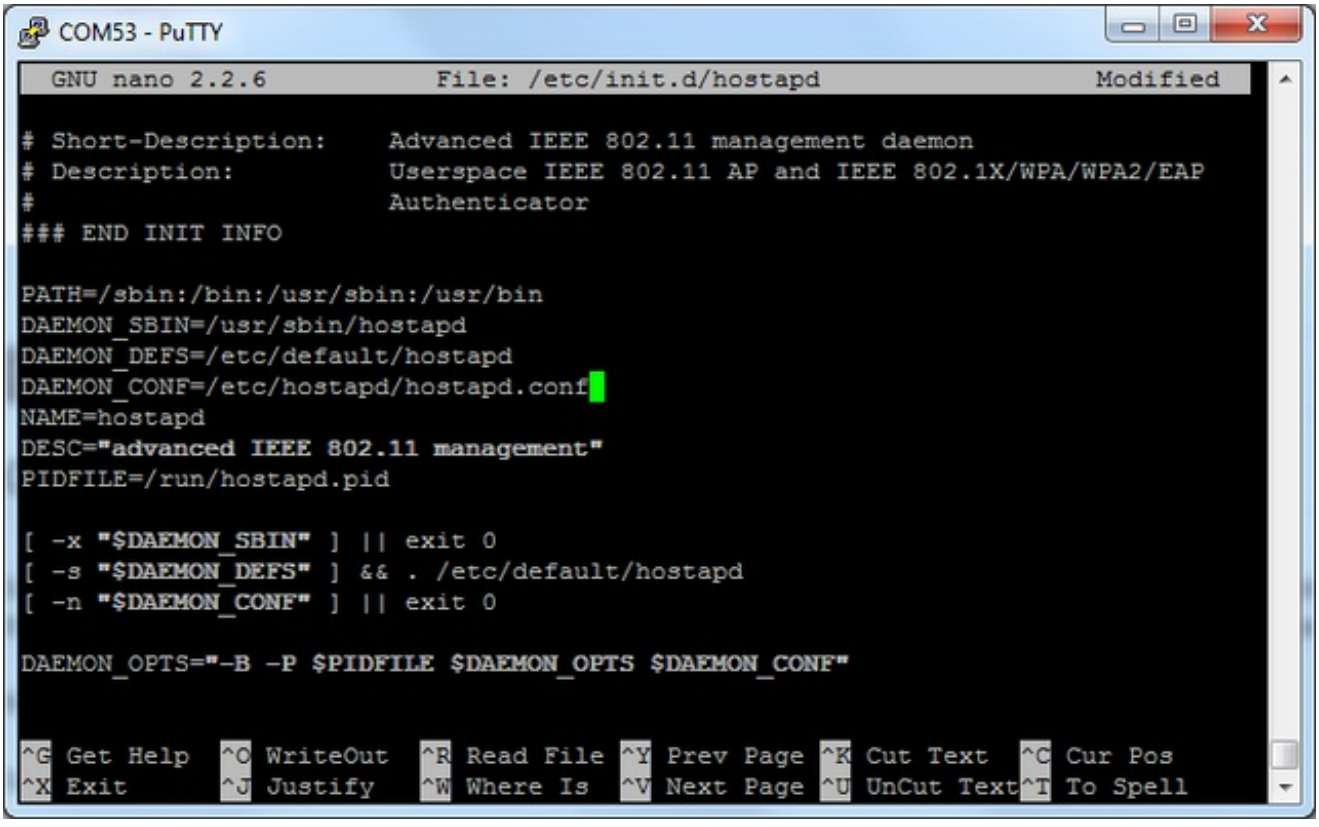


Likewise, run **sudo nano /etc/init.d/hostapd** and find the line

DAEMON_CONF=

and change it to

DAEMON_CONF=/etc/hostapd/hostapd.conf



Configure Network Address Translation

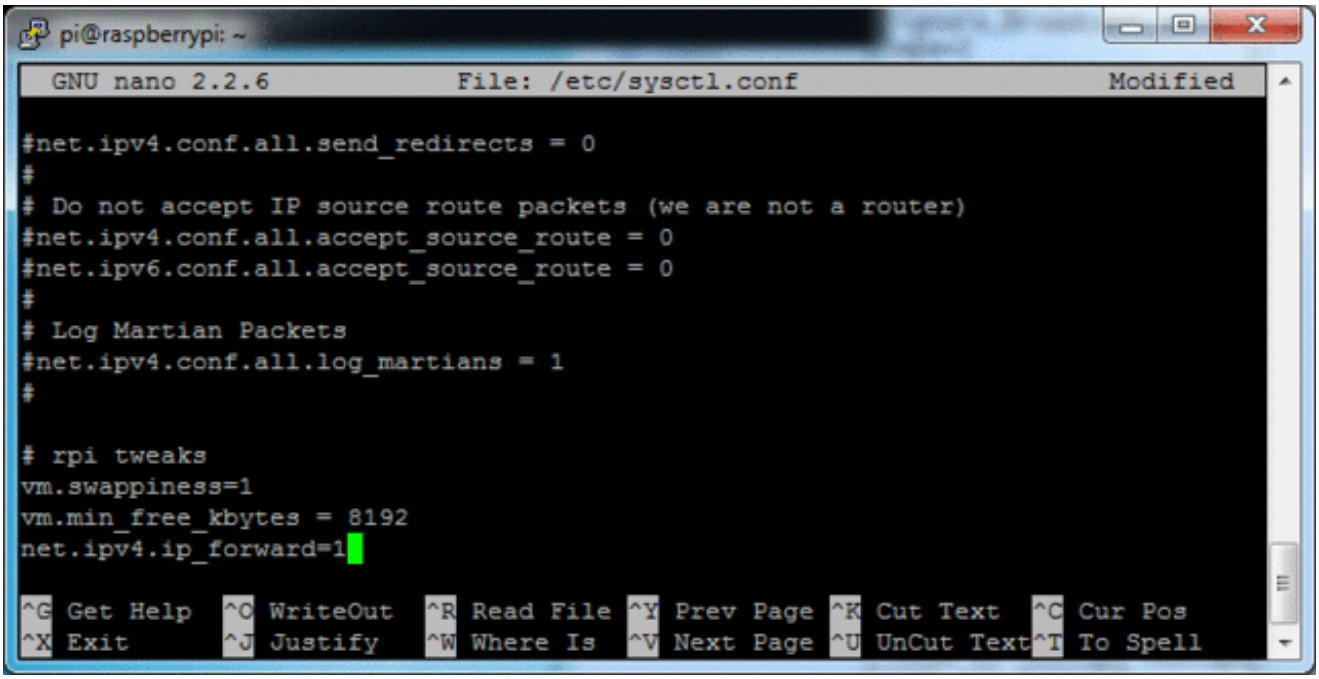
Setting up NAT will allow multiple clients to connect to the WiFi and have all the data 'tunneled' through the single Ethernet IP. (But you should do it even if only one client is going to connect)

Run sudo nano /etc/sysctl.conf

Scroll to the bottom and add

net.ipv4.ip_forward=1

on a new line. Save the file. This will start IP forwarding on boot up



Also run

sudo sh -c "echo 1 > /proc/sys/net/ipv4/ip_forward "

to activate it immediately

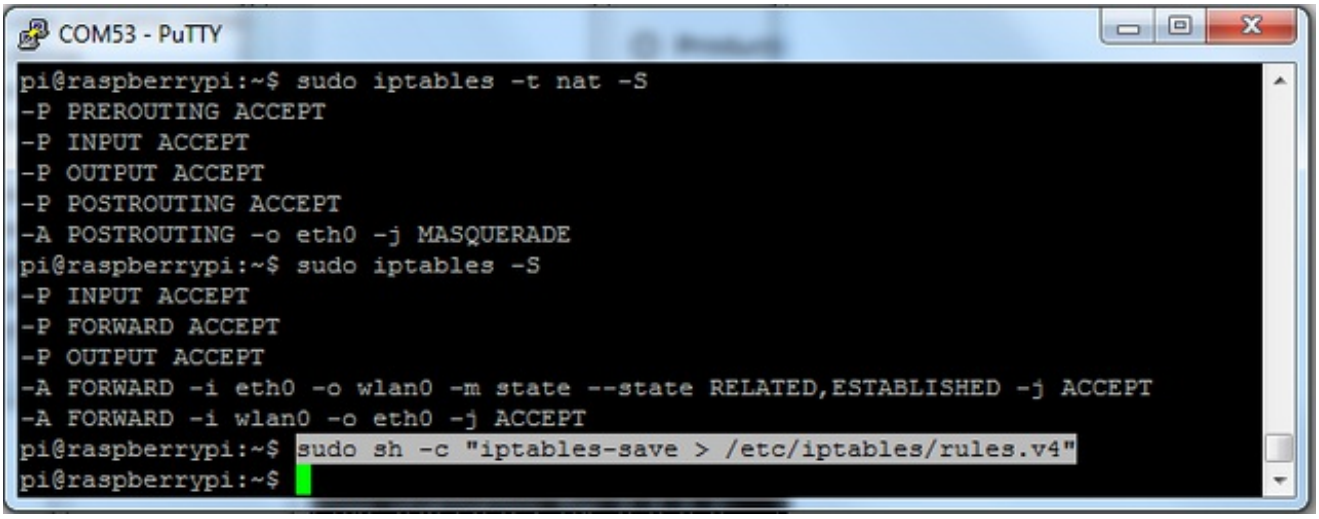
Run the following commands to create the network translation between the ethernet port **eth0** and the wifi port **wlan0**

```
sudo iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
sudo iptables -A FORWARD -i eth0 -o wlan0 -m state --state RELATED,ESTABLISHED -j ACCEPT
sudo iptables -A FORWARD -i wlan0 -o eth0 -j ACCEPT
```

You can check to see whats in the tables with

```
sudo iptables -t nat -S
sudo iptables -S
```

To make this happen on reboot (so you don't have to type it every time) run
sudo sh -c "iptables-save > /etc/iptables.ipv4.nat"



The **iptables-persistent** tool you installed at the beginning will automagically reload the configuration on boot for you.

Update hostapd (maybe)

*If you are running Raspberry pi kernel 4.4.13-v7+ or greater (check your kernel vesion with **uname -a**), you do not need to do this step.*

If you are using the Raspberry Pi 3 built-in WiFi or are not using RTL8192-like WiFi adapter, then skip this step!

Before we can run the access point software, we have to update it to a version that supports the WiFi adapter.
First get the new version by typing in

```
wget http://adafruit-download.s3.amazonaws.com/adafruit_hostapd_14128.zip
```

to download the new version (check the next section for how to compile your own updated **hostapd**) then

```
unzip adafruit_hostapd_14128.zip
```

to uncompress it. Move the old version out of the way with

sudo mv /usr/sbin/hostapd /usr/sbin/hostapd.ORIG

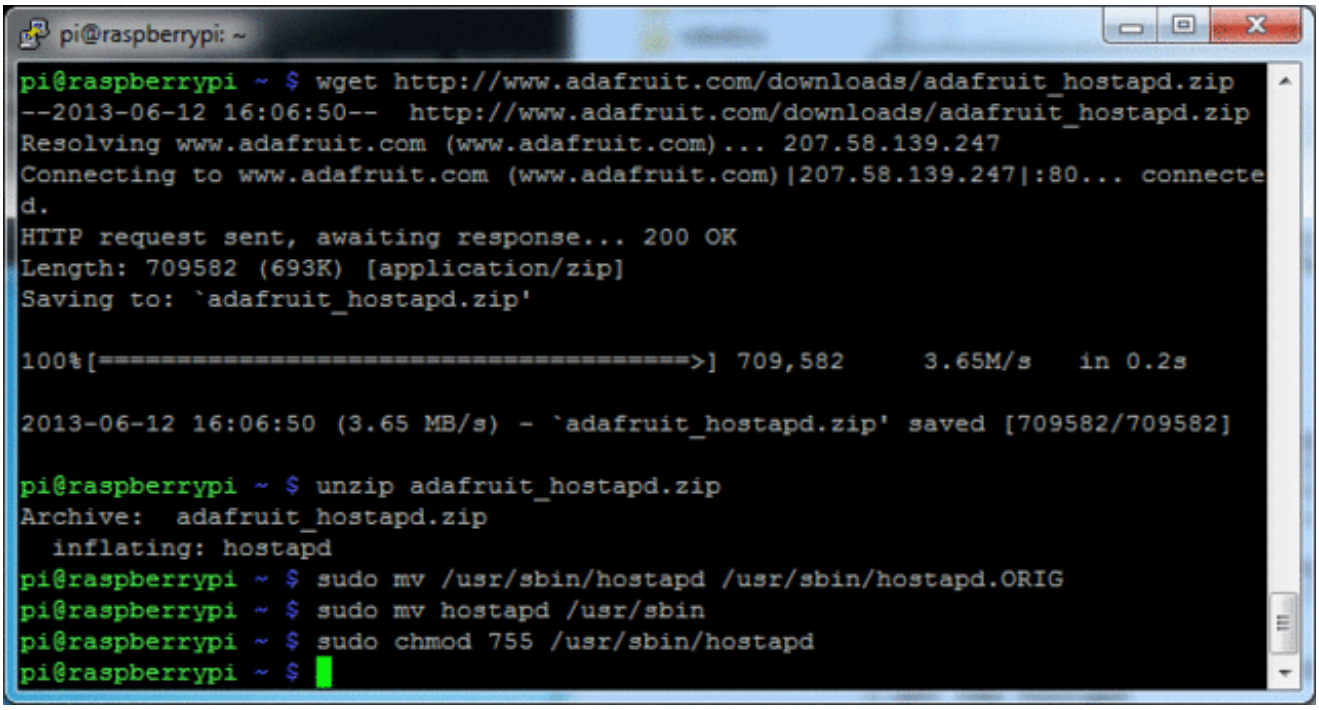
And move the new version back with

sudo mv hostapd /usr/sbin

set it up so its valid to run with

sudo chown root:root /usr/sbin/hostapd

sudo chmod 755 /usr/sbin/hostapd



First test!

Finally we can test the access point host! Run

sudo /usr/sbin/hostapd /etc/hostapd/hostapd.conf

To manually run **hostapd** with our configuration file. You should see it set up and use **wlan0** then you can check with another wifi computer that you see your SSID show up. If so, you have successfully set up the access point.

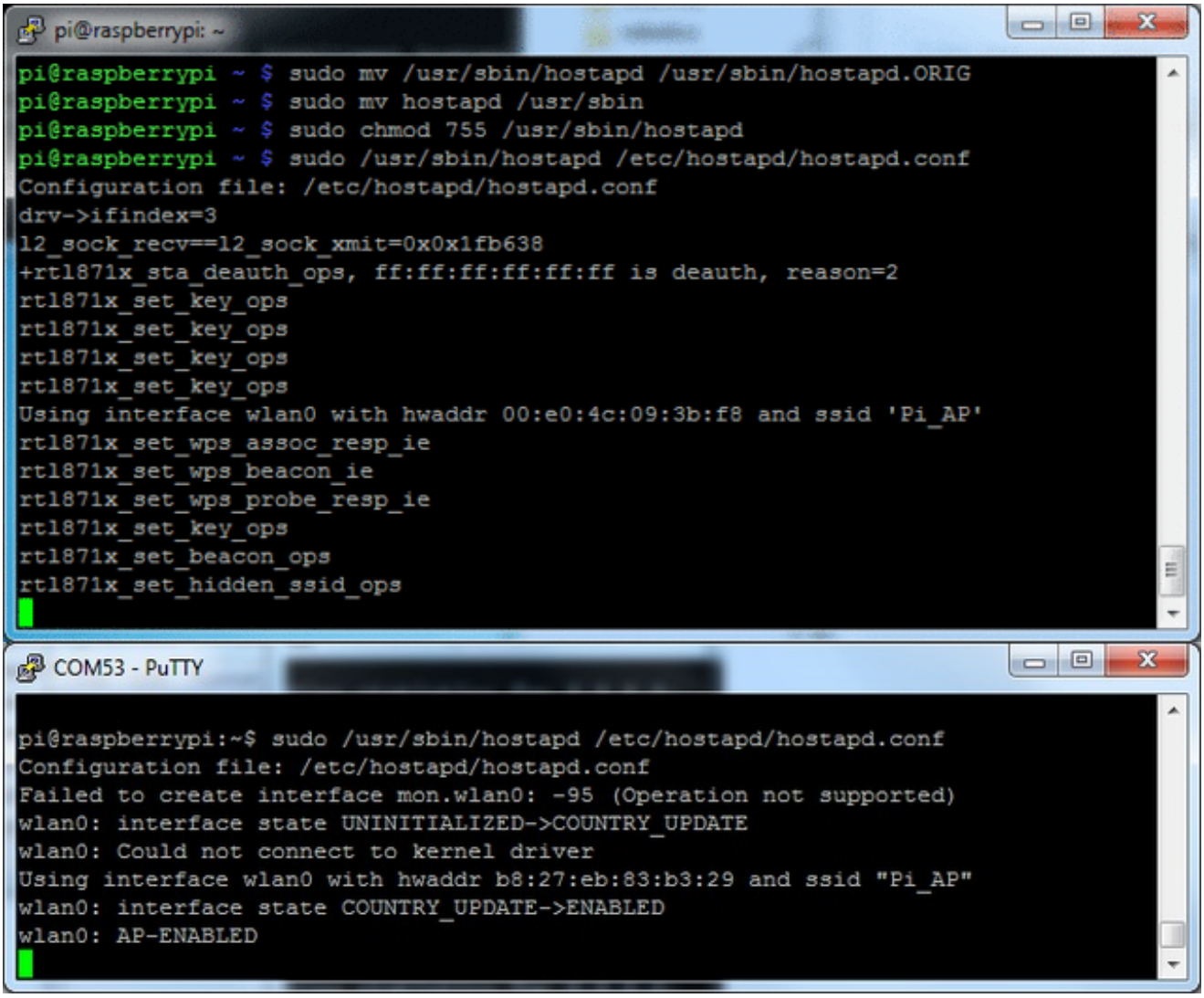
If you get this warning

Configuration file: /etc/hostapd/hostapd.conf
Line 2: invalid/unknown driver 'rtl871xdrv'
1 errors found in configuration file '/etc/hostapd/hostapd.conf'

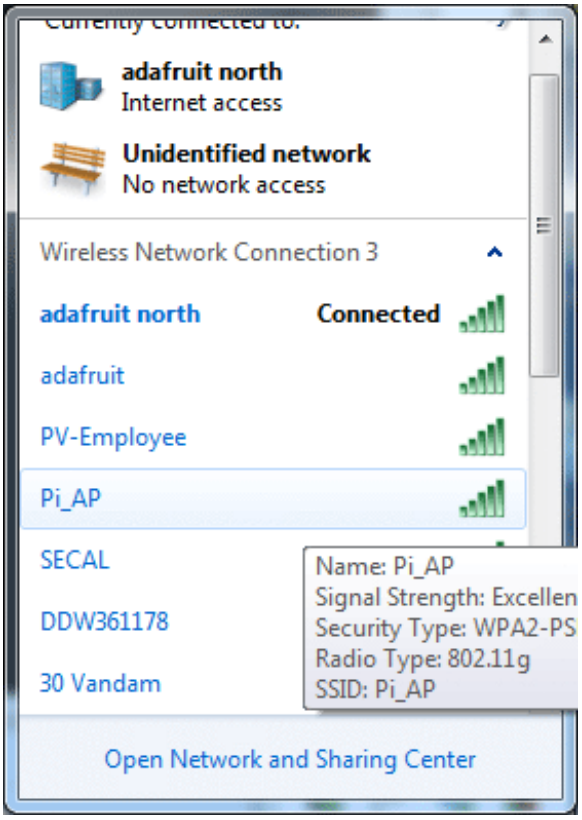
Failed to set up interface with /etc/hostapd/hostapd.conf
Failed to initialize interface

It could mean that either you are not using a RTL871Xdrv WiFi adapter (e.g. Pi 3 internal wifi) and should comment out the driver=rtl871xdrv line in the hostapd config **OR** you *are* using that chipset and you need to download our recompiled **hostapd** binary

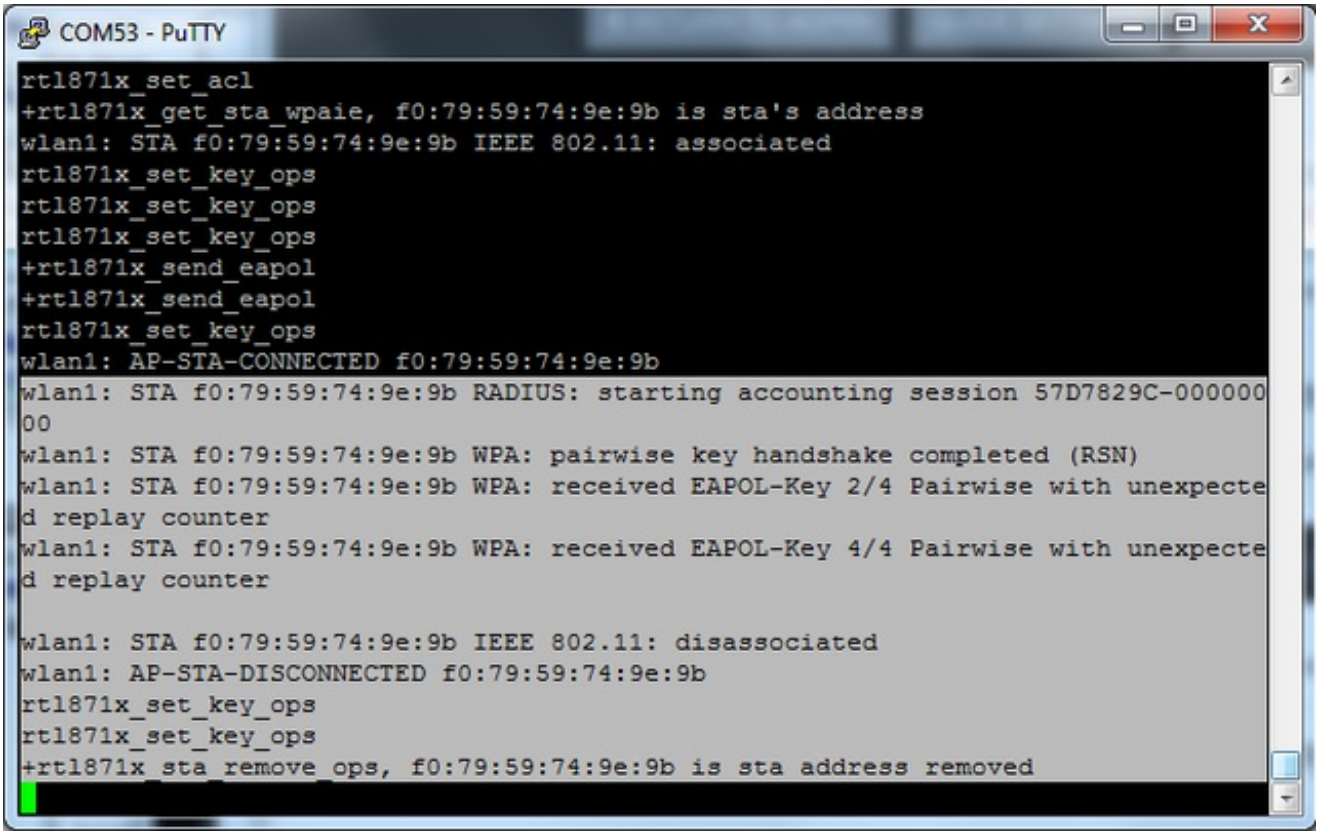
If it does work, you should get something like this:



And see a new access point created:



You can try connecting and disconnecting from the Pi_AP with the password you set before (probably Raspberry if you copied our hostapd config), debug text will display on the Pi console but you won't be able to connect through to the Ethernet connection yet.



Cancel the test by typing **Control-C** in the Pi console to get back to the Pi command line

Removing WPA-Supplicant

Depending on your distro, you *may* need to remove WPASupplicant. Do so by running this command:

```
sudo mv /usr/share/dbus-1/system-services/fi.epitest.hostap.WPASupplicant.service ~/
```

and then rebooting (**sudo reboot**) and retrying running **hostapd**

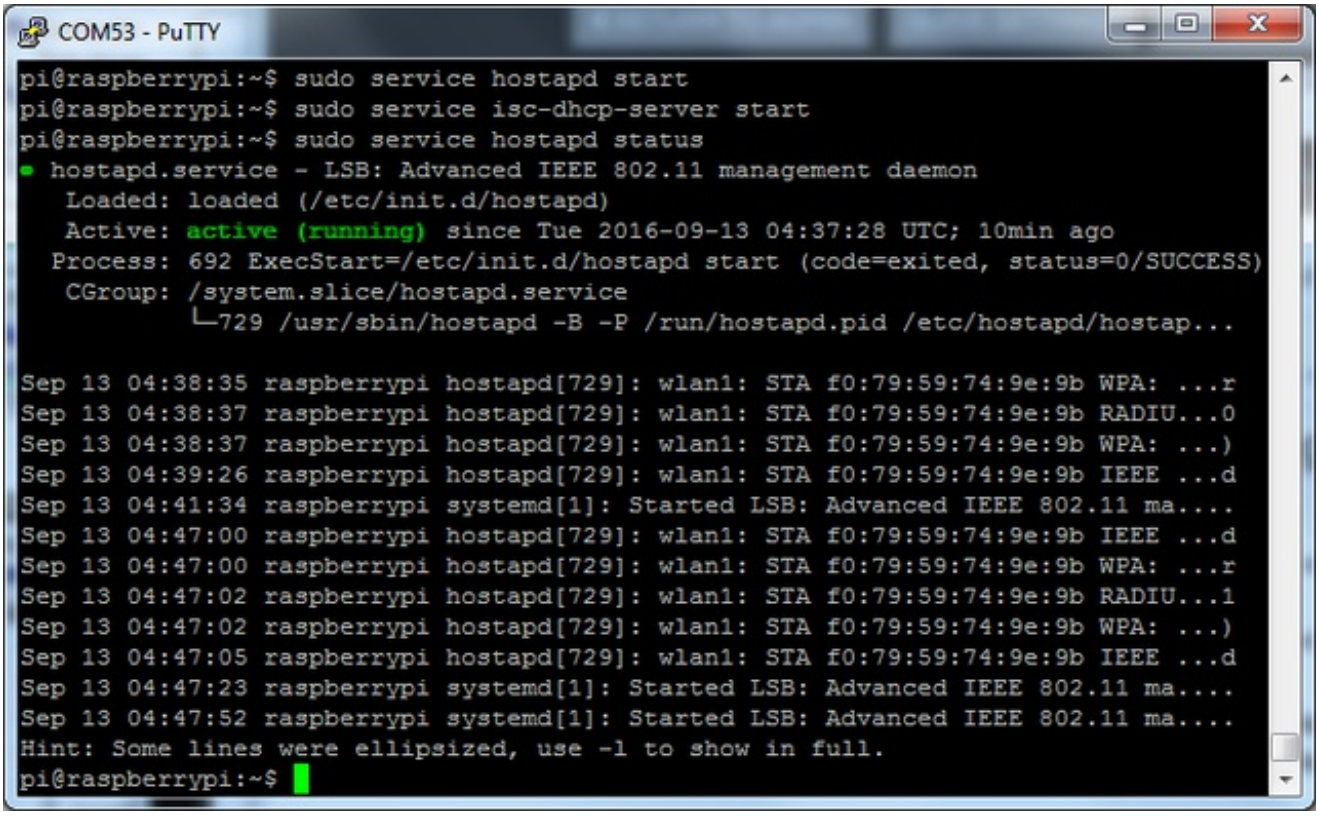
Finishing up!

OK now that we know it works, time to set it up as a 'daemon' - a program that will start when the Pi boots.
Run the following commands

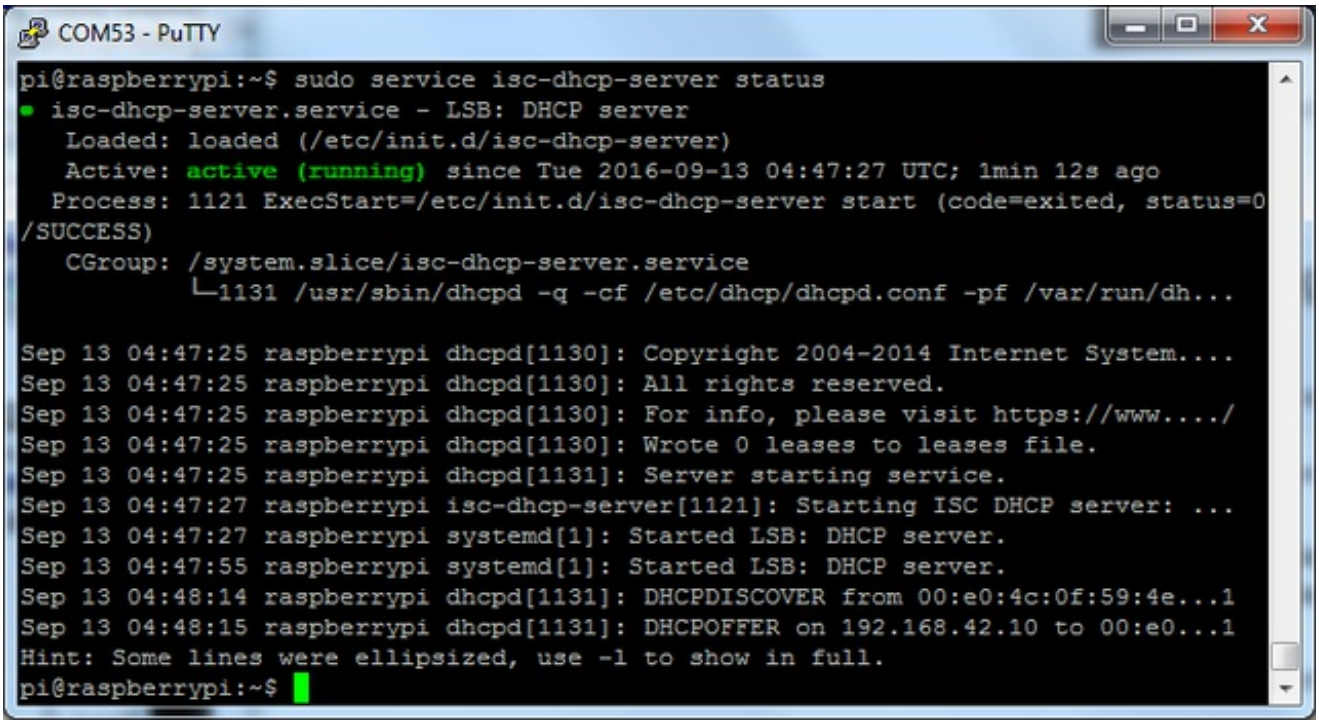
```
sudo service hostapd start
sudo service isc-dhcp-server start
```

you can always check the status of the host AP server and the DHCP server with

sudo service hostapd status



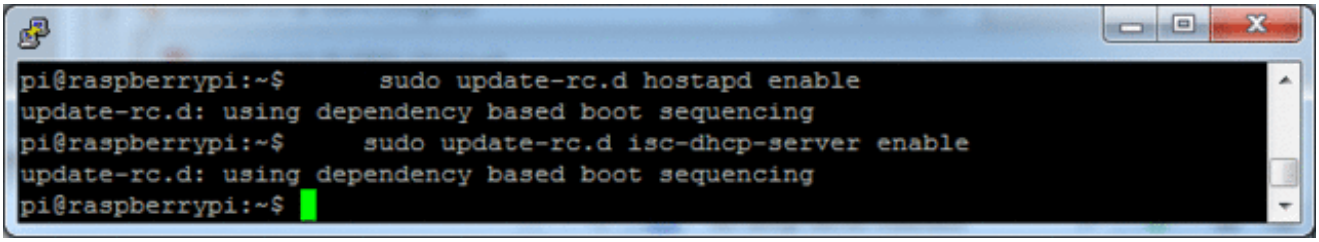
or **sudo service isc-dhcp-server status**



To start the daemon services. Verify that they both start successfully (no 'failure' or 'errors')

Then to make it so it runs every time on boot

sudo update-rc.d hostapd enable
sudo update-rc.d isc-dhcp-server enable



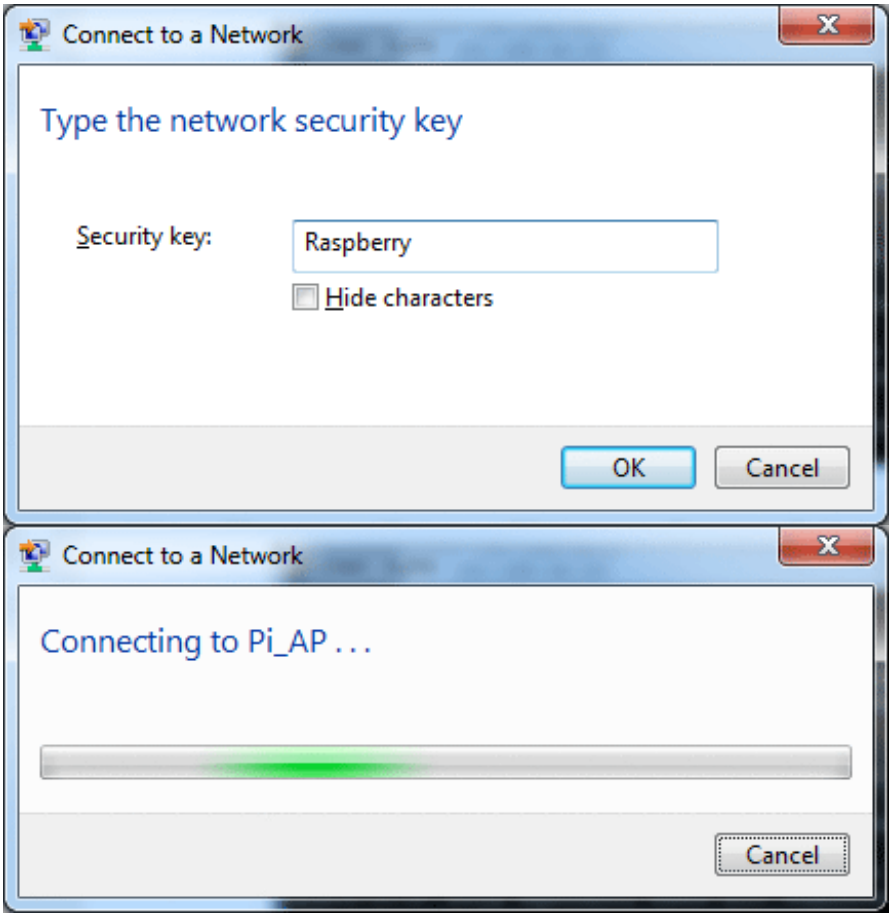
Connect and Test

Now that we have the software installed on a Pi, it's time to connect to it and test the connection. I'm using a Windows computer but any kind should work fine

On the Pi, run the command **tail -f /var/log/syslog** to watch the system log data, handy for checking and debugging whats going on!

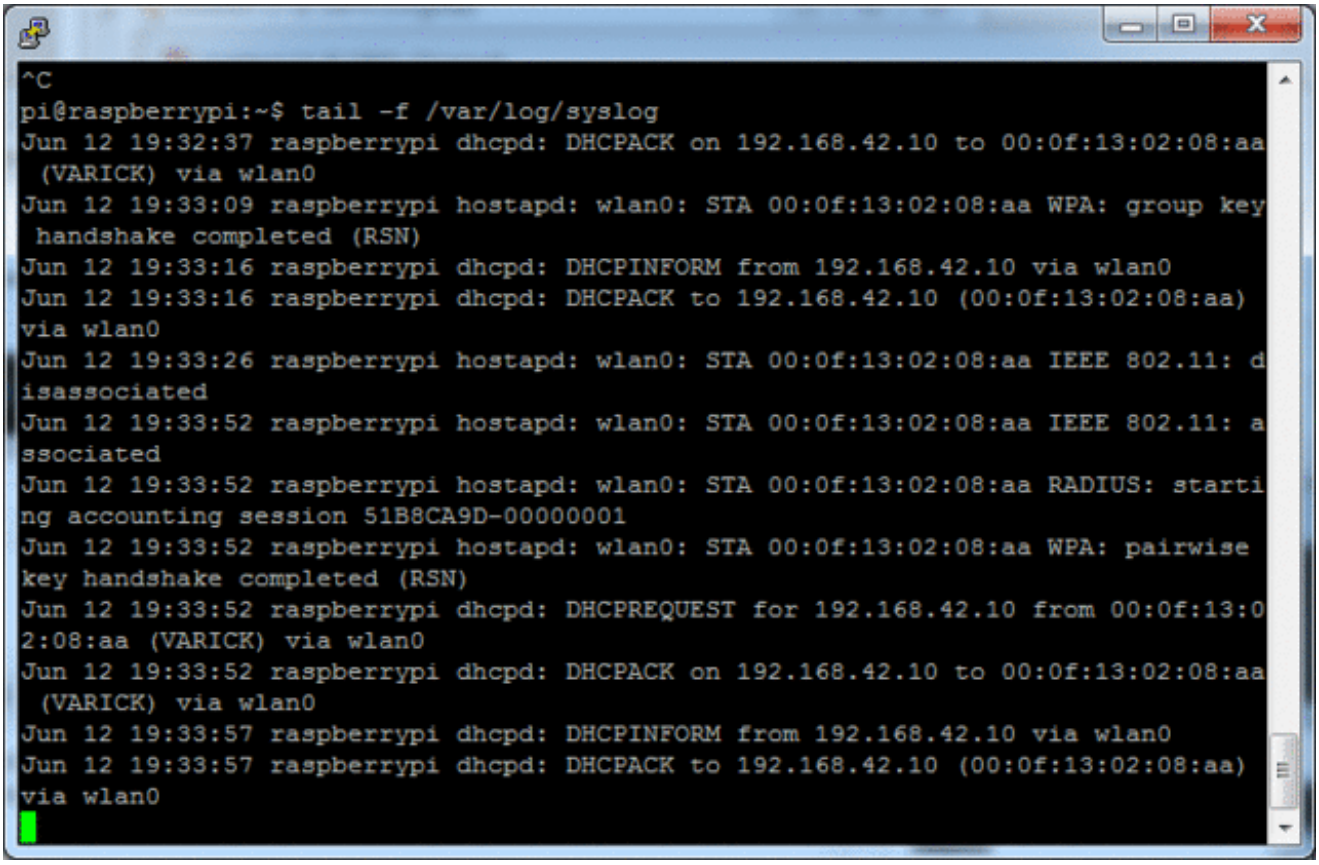
Connect with another computer to the AP you made in the previous step

Enter the WPA key you specified in the previous step



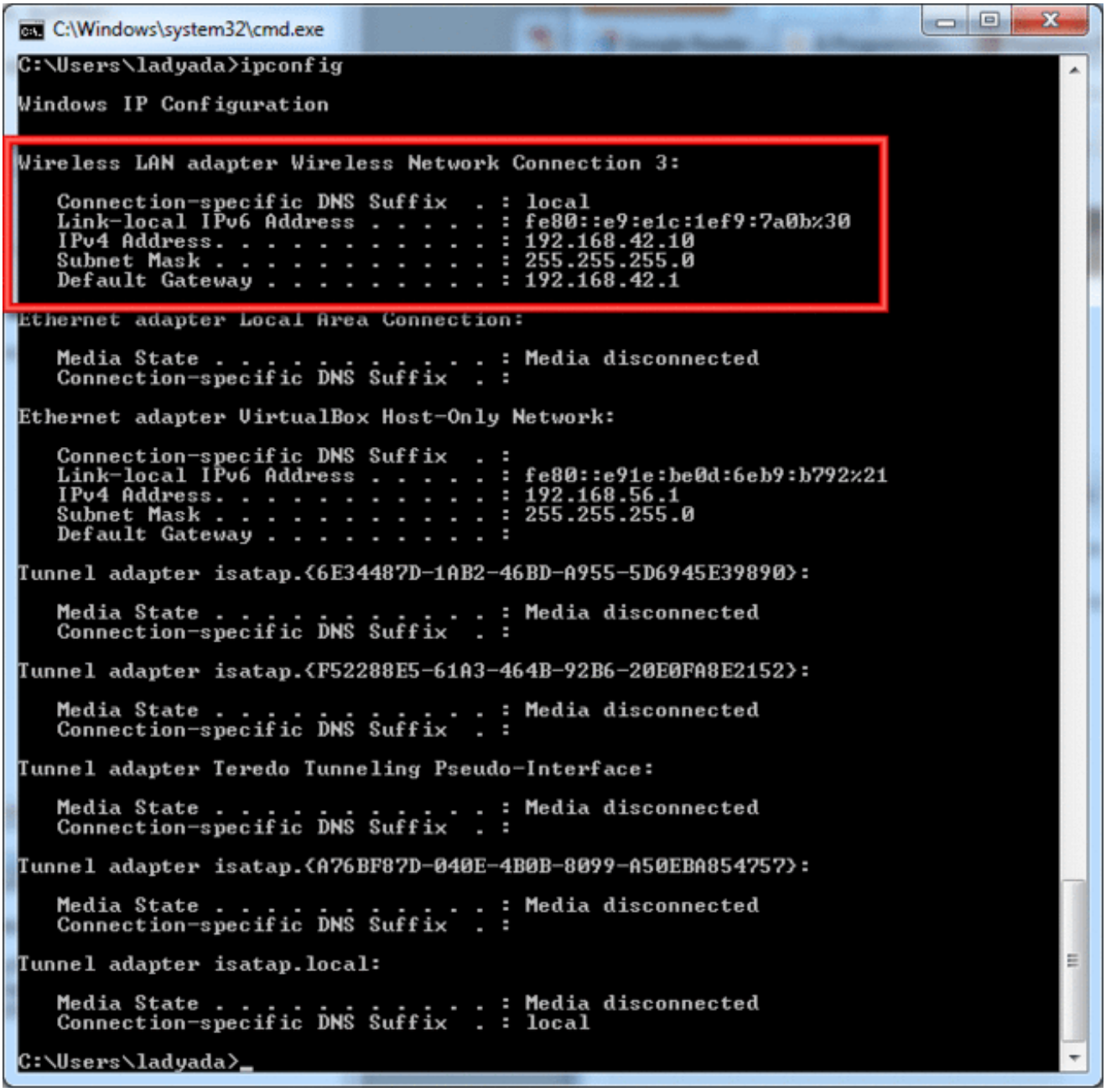
In the Pi syslog you should see stuff like this! It indicates that a client connected, at what time and what IP address was given to them

If you can't connect at all, something is wrong with**hostapd**



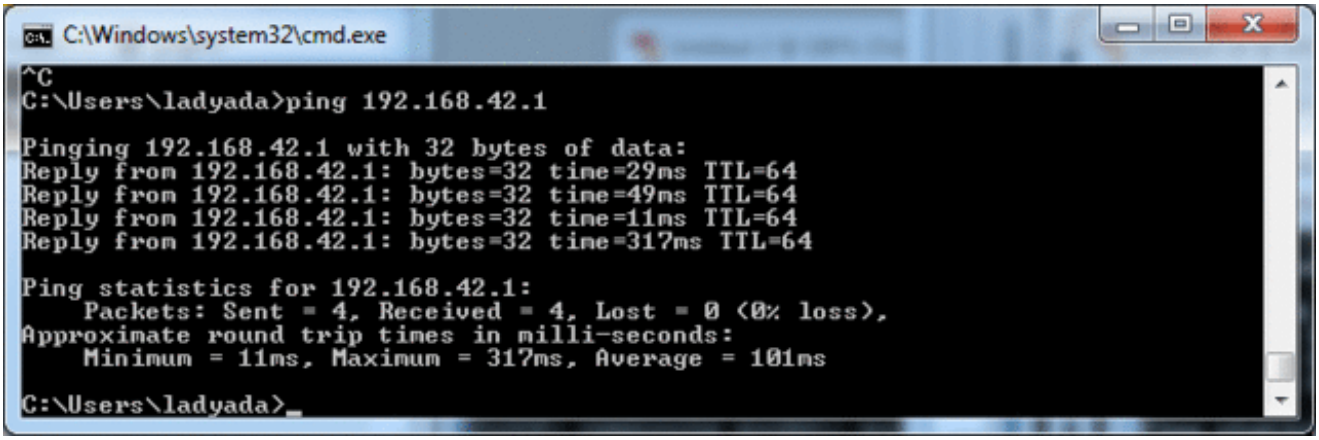
On your computer, open up a **Terminal** (mac/linux) or **Start->Run->cmd** to open up a command line

First check what **ifconfig** (mac/linux) or **ipconfig** (windows) says. You should have IP address in the 192.168.42.10-50 range

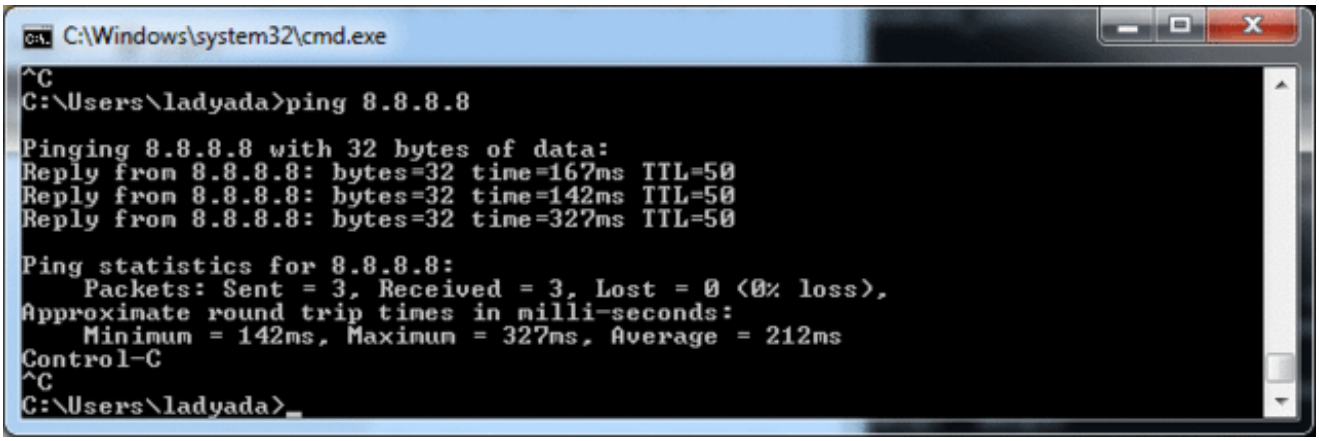


Try pinging the Pi, its address is **192.168.42.1** - on windows it will ping 3 times and quit. On mac/linux press Control-C to quit after a few pings. You should get successful pings as seen below

If that doesn't work, something is wrong with **hostapd** or **dhcpd** (more likely)



Next try ping 8.8.8.8, if this doesn't work but the previous does, something is wrong with **dhcpd** or the NAT configuration (more likely)



Finally, we'll check that DNS works, try pinging www.mit.edu (http://adafru.it/cfT). If this doesn't work, something is wrong with **dhcpd**

If everything is good so far, try browsing the internet, sending email, etc. You are now using your Pi as a Wifi Router!

More!

Its possible to set up your router for open or WEP access, but we don't cover that here (and it's not as secure!) You might want to search around for tutorials such as this one that cover (http://adafru.it/cDx)**hostapd (http://adafru.it/cDx)** options (http://adafru.it/cDx)

Compiling hostapd

This step is not required, it is for curious people only!

You may have noticed that one step is downloading a copy of hostapd from adafruit.com and swapping it with yours. In case you want to compile your own, here's how (its easy but not necessary if you are OK with using our binary)

1. Go to the Realtek downloads page http://152.104.125.41/downloads/downloadsView.aspx?Langid=1&PNid=21&PFid=48&Level=5&Conn=4&ProdID=27... (http://adafru.it/cfY)
2. Download linux 3.4.4_4749
3. Copy the zip to the SD card using any computer which will place it in the Pi's /boot directory (or somehow get that file onto your Pi)
4. Boot the Pi from the SD card
5. sudo mv /boot/RTL8192xC_USB_linux_v3.4.4_4749.20121105.zip .
6. unzip RTL8192xC_USB_linux_v3.4.4_4749.20121105.zip
7. mv RTL8188C_8192C_USB_linux_v3.4.4_4749.20121105/ rtl
8. cd rtl
9. cd wpa_supplicant_hostapd
10. unzip wpa_supplicant_hostapd-0.8_rtw_20120803.zip
11. cd wpa_supplicant_hostapd-0.8/
12. cd hostapd
13. make
14. *have a sandwich*
15. when done, **hostapd** binary is in the directory

(Download link isn't working, maybe its somewhere in http://www.realtek.com.tw/downloads/downloadsView.aspx?Langid=1&PNid=21&PFid=48&Level=5&Conn=4&DownTypeID=3&GetDown=false)