

# How to Install and Operate a Ratreflector on a Raspberry Pi

## Compiled By

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I have created an extended set of step by step instructions for setting up a Drats reflector on a Raspberry Pi. I'm always looking for ways to put the Raspberry Pi to work running ham radio applications. These instructions do not include how to connect the Pi to a Dstar radio. I hope to add an addendum on connecting the Pi to the radio.

## Step 1: Installing Drats on the Pi

The following steps are from N0SO, <http://n0so.net/index.php?id=72>.

### 1. Introduction

These instructions worked with the Raspberry Pi Debian image Raspbian "wheezy", which you can download here:

[www.raspberrypi.org/downloads](http://www.raspberrypi.org/downloads)

The latest at the time of this HOWTO writing was: 2012-12-16-wheezy-raspbian.zip

The Soft Float Debian "wheezy" image may also work, but this has not been tested. If it works, it would allow the same Raspberry Pi to run a DVAP and D-RATS.

The installation instructions that follow assume you have already have a working Raspberry Pi running Debian Raspbian "wheezy".

### 2. Installation

2.1 Open a command shell.

2.2 Get the latest updates. Enter:

```
sudo apt-get update
```

2.3 Wait for the update to complete.

2.4 Enter:

```
sudo apt-get upgrade
```

2.5 Wait for the upgrade to complete

2.6 Repeat 2.2 - 2.5 until no more updates are found.

2.6.1 At this point you might want to make sure the keyboard mapping is set for a US keyboard instead of the defaulted Great Britain. If you need to change the mapping to go Step 6 Number 2.

2.7 The release version of D-RATS is available in the Raspbian "wheezy" Apt repository. D-RATS also needs the following packages to be installed:

```
python-libxml2 python-libxslt1 python-serial python-glade2
```

Installing D-RATS from the repository will install everything D-RATS needs to run, except one package:

```
python-glade2.
```

It will have to be installed via an additional apt-get command.

2.8 Enter:

```
sudo apt-get install d-rats
```

2.9 Wait for the installation to complete. This will install all of the packages listed in 2.7 except python-glade2, which will take some time.

2.10 Install python-glade2. Enter:

```
sudo apt-get install python-glade2
```

2.11 Wait for the install to complete. Again, this may take some time, and may install more packages required by python-glade2.

2.12 Installation is complete; you may now run d-rats and configure it for your needs.

2.12.5 Don't run Drats yet. Instructions on how to configure the ratreflector will be explained further in this document.

2.13 To run the gui application on the Pi, the command is “startx”

## Step 2: Determine Your Internet IP Address

1. From the Pi Desktop, launch a browser and go to <http://www.whatismyip.com>. Make sure to write down the IP address.
2. Logout of the GUI.

## Step 3: Determine IP Address of the Pi on Your Network and How to Give Your Pi a Static IP Address

1. The following instructions come from ModMyPi, <http://www.modmypi.com/blog/tutorial-how-to-give-your-raspberry-pi-a-static-ip-address>
2. **Tutorial - How to give your Raspberry Pi a Static IP Address** July 19, 2013
3. To log into your Raspberry Pi remotely to connect to Drats, you'll need the IP of the Raspberry Pi – this is basically like your house address and tells the host computer where to look for it on the network. By default, the Raspberry Pi will be given an IP automatically by the router (called Dynamic IP and denoted by DHCP) when you connect to a network. However, this can change whenever you remove the Pi from the network e.g. turn it off.
4. Having a static IP isn't essential; however it will make repeated access to the Raspberry Pi via SSH much simpler, as you'll always know that the Raspberry Pi has the same address. Imagine how much trouble your postman would have if your house constantly changed location :)
5. This task assumes that you have the official Raspian OS release installed. This is available in the NOOBS distribution and can be downloaded from <http://www.raspberrypi.org/downloads>. This guide also assumes that you've connected your Pi to a network via Ethernet. If you're going to be logging into your Pi remotely for most tasks, then I recommend it's easiest and fastest to plonk it next to your router, and use Ethernet to access the internet anyway!
6. **A. Checking Set Up**
7. Boot into Raspian and log in (Username. pi, Password. raspberry), this will all be command line stuff, so no need to log in to the GUI.
8. First, we need to list the network interface we currently have available:
9. *cat /etc/network/interfaces*

```
pi@raspberrypi: ~
pi@192.168.1.81's password:
Linux raspberrypi 3.6.11+ #371 PREEMPT Thu Feb 7 16:31:35 GMT 2013 armv6l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Fri Jul 19 11:17:06 2013 from 192.168.1.86
pi@raspberrypi ~ $
pi@raspberrypi ~ $
pi@raspberrypi ~ $
pi@raspberrypi ~ $ cat /etc/network/interfaces
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
pi@raspberrypi ~ $
```

10. The line . . . **iface eth0 inet dhcp**
11. Implies that we're currently getting out IP address via DHCP, meaning it's being dynamically registered by the router. This is what we want to change!
12. **B. Gathering Information**
13. First of all we need to grab some information from our router and Pi. There's a couple of commands we need to run to get this info. Have a pen and paper handy! . . .
14. *ifconfig*

```
pi@raspberrypi: ~  
pi@raspberrypi ~ $ ifconfig  
eth0      Link encap:Ethernet  HWaddr b8:27:eb:b3:fc:2e  
          inet addr:192.168.1.81  Bcast:192.168.1.255  Mask:255.255.255.0  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:4078 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:256 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:264593 (258.3 KiB)  TX bytes:31343 (30.6 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:8 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:8 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:1104 (1.0 KiB)  TX bytes:1104 (1.0 KiB)  
  
wlan0    Link encap:Ethernet  HWaddr 00:0f:54:12:15:97  
          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 ~ $ █
```

15. This reveals your router information, the bit you want is after eth0 (the ethernet connection). .  
    **.eth0 Link encap:Ethernet HWaddr b8:27:eb:b3:fc:2e**
16. **inet addr:192.168.1.81 Bcast:192.168.1.255 Mask:255.255.255.0**
17. Write down the following information. . .
18. **inet addr** – 192.168.1.81 (Pi's Current IP Address)
19. **Bcast** – 192.168.1.255 (The Broadcast IP Range)
20. **Mask** – 255.255.255.0 (Subnet Mask Address)
21. We need a little more information before we proceed. Use the command. . .
22. *netstat -nr* (route -n will give you the same info.)

```
pi@raspberrypi: ~
login as: pi
pi@192.168.1.81's password:
Linux raspberrypi 3.6.11+ #371 PREEMPT Thu Feb 7 16:31:35 GMT 2013 armv6l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Fri Jul 19 11:17:48 2013 from 192.168.1.86
pi@raspberrypi ~ $ netstat -nr
Kernel IP routing table
Destination      Gateway          Genmask         Flags   MSS Window  irtt Iface
0.0.0.0          192.168.1.254  0.0.0.0         UG        0 0          0 eth0
192.168.1.0      0.0.0.0         255.255.255.0   U         0 0          0 eth0
pi@raspberrypi ~ $ █
```

23. We need:

24. **'Gateway'** Address – 192.168.1.254

25. **'Destination'** Address – 192.168.1.0

### 26. **C. Editing Network Configuration**

27. We now need to plug this information into the Pi's network configuration file using a text editor. I always use nano text editor. . .

28. *sudo nano /etc/network/interfaces*

```
pi@raspberrypi: ~
GNU nano 2.2.6 File: /etc/network/interfaces
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

[ Read 9 lines ]
^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
```

29. Simply change the line that reads:
30. **iface eth0 inet dhcp**
31. to
32. **iface eth0 inet static**
33. Then directly below this line enter the following (Please Note. **You will need your own addresses we gathered in Part B, more details below**). . . .
34. **address 192.168.1.81**
35. **netmask 255.255.255.0**
36. **network 192.168.1.0**
37. **broadcast 192.168.1.255**
38. **gateway 192.168.1.254**
39. To clarify what each part means. . . .
40. **address** – The address you want to give your Pi, this can be any IP in the network range, but it's usually advisable to go higher rather than lower, or you could end up logging different devices to the same IP! I've selected 192.168.1.81, as we're already registered to that address (denoted by '**inet addr**'), but this can be any IP address from the range 192.168.1.1 to 192.168.1.255.
41. **netmask** – The '**Mask**' address we wrote down earlier.
42. **network** – The router IP address, this is the '**Destination**' Address was found earlier. You can also grab this off your router, it will say on the side somewhere.
43. **broadcast** – The '**Bcast**' address we wrote down earlier.
44. **gateway** – This is the '**Gateway**' address we found earlier.

```
pi@raspberrypi: ~
GNU nano 2.2.6 File: /etc/network/interfaces Modified
auto lo

iface lo inet loopback

iface eth0 inet static
address 192.168.1.81
netmask 255.255.255.0
network 192.168.1.0
broadcast 192.168.1.255
gateway 192.168.1.254

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
```

45. So, it should look something like the above, but with your values! Remember to save before exit, CTRL+X (exit) then yes to save changes!
46. **D. Re-check Static IP Configuration**
47. **UPDATE:** Remove any existing leases
48. *sudo rm /var/lib/dhcp/\**
49. Then we'll need to reboot and check your changes. . .
50. *sudo reboot*
51. Log back in and run
52. *ifconfig*
53. This should reveal your new settings.

```
pi@raspberrypi: ~  
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent  
permitted by applicable law.  
Last login: Fri Jul 19 12:49:54 2013 from 192.168.1.86  
pi@raspberrypi ~ $ ifconfig  
eth0      Link encap:Ethernet  HWaddr b8:27:eb:b3:fc:2e  
          inet addr:192.168.1.81  Bcast:192.168.1.255  Mask:255.255.255.0  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:177 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:74 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:14754 (14.4 KiB)  TX bytes:10131 (9.8 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:1 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:1 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:95 (95.0 B)  TX bytes:95 (95.0 B)  
  
wlan0     Link encap:Ethernet  HWaddr 00:0f:54:12:15:97  
          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 ~ $ █
```

54. To double checks all is working as it should, ping your 'Gateway' Address. . .

55. *ping 192.168.1.254 -c 10*

56. (the -c 10 command simply denotes that you want to ping it 10 times, if you forget to add this, it will ping the address continuously. To stop it, press CTRL+C)

```
pi@raspberrypi: ~  
pi@raspberrypi ~ $ ping 192.168.1.254 -c 10  
PING 192.168.1.254 (192.168.1.254) 56(84) bytes of data.  
64 bytes from 192.168.1.254: icmp_req=1 ttl=255 time=3.51 ms  
64 bytes from 192.168.1.254: icmp_req=2 ttl=255 time=2.49 ms  
64 bytes from 192.168.1.254: icmp_req=3 ttl=255 time=3.25 ms  
64 bytes from 192.168.1.254: icmp_req=4 ttl=255 time=3.61 ms  
64 bytes from 192.168.1.254: icmp_req=5 ttl=255 time=3.43 ms  
64 bytes from 192.168.1.254: icmp_req=6 ttl=255 time=4.30 ms  
64 bytes from 192.168.1.254: icmp_req=7 ttl=255 time=3.00 ms  
64 bytes from 192.168.1.254: icmp_req=8 ttl=255 time=2.75 ms  
64 bytes from 192.168.1.254: icmp_req=9 ttl=255 time=2.97 ms  
64 bytes from 192.168.1.254: icmp_req=10 ttl=255 time=3.01 ms  
--- 192.168.1.254 ping statistics ---  
10 packets transmitted, 10 received, 0% packet loss, time 9014ms  
rtt min/avg/max/mdev = 2.499/3.238/4.309/0.488 ms  
pi@raspberrypi ~ $
```

57. This should ping successfully and all packets should be received. If something's not right double check through all your IP addresses, and make sure you're pinging the right address too. Remember you can always revert back to DHCP by reversing the steps. The 'network' router IP address is sometimes a little fiddly, so check that if you're still having issues!
58. Hopefully however, your Raspberry Pi is now set up with a static IP address!

## Step 4: How to Portforward Port 9000 on the Router

1. These steps need to be performed from a computer connected directly to your router. I did not try this using a wireless connection.
2. Port 9000 (I used 9000-9500) both TCP and UDP need to be opened on your network router so the Pi ratflector can be reached from outside your internal network.
3. Because there are so many different routers being used, the best way to open the ports is by going to <http://portforward.com/> and look for the directions for your router.
4. I found the easiest way to do this is to download Port Forward Network Utilities from the same site.
5. Port Forward Network Utilities with both open the ports and test to see if the ports are open.

# Step 5: How to Set Up the Ratflector on the Pi

1. Some of the steps listed below, have already be done and you don't need to repeat them. This information comes from the <http://www.d-rats.com/documentation/4-howtos/29-running-your-own-ratflector/>

## 1. Introduction

The repeater application that comes with D-RATS is poorly named and is the source of constant confusion for users. Some call it the repeater, some call it the ratflector, and others call it the network proxy. Regardless of what you call it, this document is aimed at explaining what it does, what you can do with it, and how to do some of those things.

## 2. What it Does

The repeater application works like an Ethernet switch, for those that understand that analogy. If not, imagine it like a Y-adapter or a USB hub. It allows multiple connections to talk to each other. Sort of a concentrator of D-RATS traffic that can bridge multiple modes. If you hook two radios to it, it will behave somewhat like a repeater: any data traffic that comes in on one radio will go out on the other radio. This could be useful for a cross-band digital data repeater.

If you enable network access, then a user from a networked computer could connect to the repeater and see the RF traffic, as well as communicate with other RF users. This means you can locate your main D-RATS PC away from the radio (connected by a LAN) or allow multiple stations to share a single radio. It also allows you to let people come in from across the globe to communicate with RF stations in your area.

If you establish a link between your repeater and another repeater over a network or the internet, then you can bridge your local RF users to remote RF users.

## 3. Topology

The repeater behaves somewhat like an Ethernet switch. If a packet comes in via one path and has an explicit destination, the repeater will do one of two things:

- If the destination station is known to exist on one of the other attached paths, it will send the packet directly there and anyone else will not see it
- If the destination station is not known (or was last heard more than ten minutes ago) then it will broadcast the packet to all connected paths

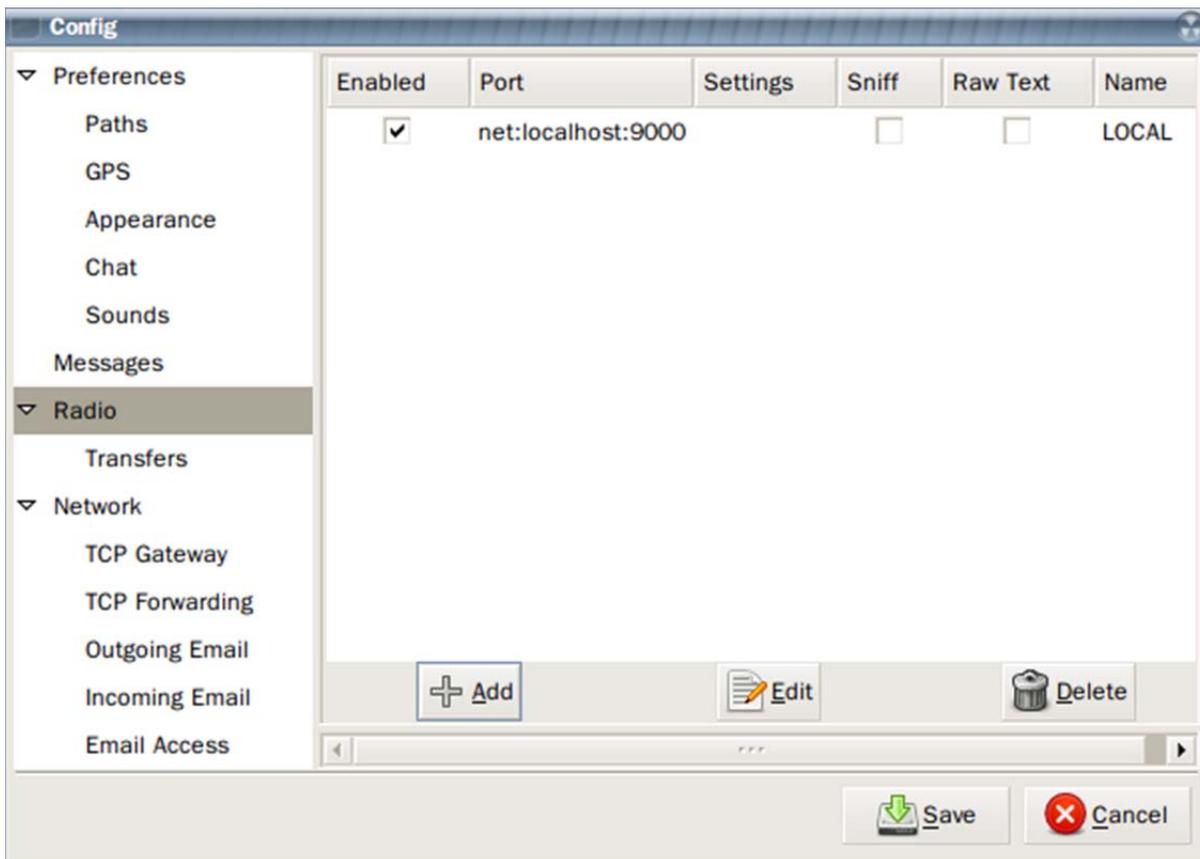
Any packet addressed to CQCQCQ (such as a chat packet or a broadcast ping) will always be sent to every port. The repeater determines which station(s) it has heard on a given path by noting that the station has sent a packet from that path. This means that if you simply connect to a path of the repeater, the repeater doesn't know where you are until you send something to it (such as a chat message, a ping to another station, etc).

### 3.1. Scenario 1: An internet reflector

Start the D-Rats Repeater program. Then make sure that "Allow incoming network connections" is checked and hit the "On" button. Simple! Internet users can connect to this proxy by connecting to your system via an IP address or DNS name. If you're behind a firewall, you'll need to forward ports (9000 in the default case) through to your internal machine so people from the outside can connect and you'll need to tell them your external IP address.

Notes:

- **Determining your IP Address:**  
Open your web browser and go to <http://www.whatismyip.com/>. Your IP address will appear at the top of the screen. This is the number that D-RATS users will put in the host address line when making a connection to your ratflector. This should be a "static" or unchanging address, or a Domain Name. If you have a "dynamic" or changing IP address, it is only temporary and may change every time you start your computer. It will work in the short term, for testing
- **Firewalls and Anti-Virus programs:**  
You may need to tell your computer and/or your router to allow TCP and UDP access to the port number(s) selected for D-RATS use. If running the drats\_repeater on a Windows platform, you may also have to tell your anti-virus and anti-malware software to allow d-rats\_repeater.exe access to the Internet. If it "just won't work", try temporarily turning off the firewall and anti-virus long enough to determine if they are blocking D-RATS.



Users can connect to this proxy by connecting to your system via an IP address or DNS name. If you're behind a firewall, you'll need to forward ports (9000 in this case) through to your internal machine so people from the outside can connect.

**NOTE:** Please take into consideration the RF network you're providing access to. If you're linked to a repeater, make sure the owner approves of the additional data load. If that repeater is linked to a reflector, it's probably not appropriate to provide access to external users that don't realize this unless the reflector owner has made specific provisions for data use. **If you abuse the ability to link network users to RF you will inevitably find data operation banned on the various network nodes.**

## Step 6: How get the Pi Ratreflector on the Internet

1. In order to connect to the ratreflector on the Pi, the easiest is to set up a new radio on Drats that uses the IP address of your network with port 9000 and name it according to what the ratreflector is being used.
2. If you don't want to give out your network IP address, you will need to create a subdomain on a webhosting site for your domain that points to your IP address on your network.
3. If you don't have your own domain name and hosting site, you might try contacting someone who does and use theirs.
4. According to Godaddy, it could take 48 hours or more for the subdomain to become populated and working.
  - a. If you are using Godaddy for your domain name and hosting, there are two settings on Godaddy that you need to change to get it forward to rat.domain.com setting.
  - b. First go to the domain settings and create a new subdomain rat. This subdomain should point to the IP address of your local IP address. Set the subdomain to forward and mask.
  - c. Second under the DNS Zone File tab, set the rat zone file to point to the same IP address.

## Step 6: Notes and Helpful Links

1. I had a problem with Drats crashing on the Pi when I created a radio on Drats that pointed to itself. You can use the command `sudo apt-get remove d-star` to remove it from the Pi. Next you need to use the command `sudo apt-get purge d-star`. You may also need to clear out and delete all files and folders on the Pi in `.d-rats`. Restart the Pi before reinstalling d-rats.
2. Another and easier way of recovery the Pi to restore the Pi image, is to make a clone of your Pi SD card. I recommend that you do this after each major step of the project giving each clone of the image a new version number so you can go back to any step. The instruction can be found at <http://lifehacker.com/how-to-clone-your-raspberry-pi-sd-card-for-super-easy-r-1261113524>

### 2.1 Easy Reinstallations

#### 2.1.1 Cloning the SD card is simple. Just follow these steps:

- A. Get everything set up just the way you want it on your Raspberry Pi, whatever you're using it for. Then shut down the Pi and remove the SD card. Insert the SD card into your computer.
- B. Start up [Win32DiskImager](#), a program that you probably have from [when you first set up your Pi](#). (If you're on OS X or Linux, you'll have to [use the dd command as described here](#) instead of these steps).
- C. In the "Image File" box, enter the path of your soon-to-be image file. For example, I put mine in `C:\Users\Whitson\images\myraspbmc.img`
- D. Under the "Device" box, select your SD card.
- E. Click the "Read" button to create the image file from your card.
- F. When it's done creating the image file, you can eject your SD card and put it back in your Raspberry Pi. Keep that IMG file in a safe place.

#### 2.1.2 Restoring the SD cards just follow these steps:

Now, if anything ever goes wrong with your Pi, you can restore your fully-set-up image using the reverse instructions:

- A. Insert the SD card back into your computer.
- B. Head to the start menu or screen and type "disk management." Open the disk management program and find your SD card in the list.
- C. Right-click and delete all the partitions on your SD card. When it's empty, right-click on it and format it (it doesn't matter what filesystem you format it to, your computer just needs to recognize it).
- D. Open Win32DiskImager again and browse for your image file. Select your device from the Device dropdown just as you did before.
- E. This time, click "Write" to write the image to the SD card.
- F. When it finishes, eject the SD card and re-insert it into your Raspberry Pi. When you boot it up, it should be in the exact same state it was in when you first cloned the SD card.

Once you've done this, setting up your Pi from scratch will be a whole lot simpler!

3. I had a problem with the Pi **Mis-Mapping the keyboard** to the UK mapping which is the default. To change it map to the US keyboard

<http://www.element14.com/community/thread/24566/1/solved--mis-mapped-keyboards-for-rpi?displayFullThread=true>)

- A. When we downloaded the Distribution file, it came with a default parameter putting our location in Great Britain. Unless you know about it, confusion will reign because you will think you are configuring the keyboard correctly.
- B. So for the Raspberry Pi you need to open the file “keyboard” and edit it.
- C. `sudo nano /etc/default/keyboard`
- D. will open the file and you just type over two characters in the line
- E. `XKBLAYOUT="gb"` to read `XKBLAYOUT="us"`,
- F. Ctrl X, Y and reboot. Then you can reconfigure the RPi.

#### 4. Finishing touches: Booting Directly To D-Rats and D-Rats Repeater

- A. It might be helpful to have the Pi boot directly to the Desktop and automatically run D-rats and D-Rats Repeater.
- B. The first step is have D-Rats and D-Rats Repeater start with the Desktop.
- C. Edit the autostart config file to launch the two programs. It is important the D-Rats Repeater start first.
- D. Enter the following command at the command prompt to edit the autostart file: *sudo nano /etc/xdg/lxsession/LXDE/autostart*. You may want to look in LXDE-pi folder for the autostart file.
- E. After the last line in the autostart file add the following in this order:
  - i. `@d-rats_repeater`
  - ii. `@d-rats`
- F. Exit the file and save the changes.
- G. Reboot the Pi
- H. After you have logged back into the Pi and are back at the command prompt, use the command *startx* to start the Desktop and check to see if D-Rats and D-Rats Repeater start automatically.
- I. If it is working. logout of the Desktop back to the command prompt.
- J. Enter the following command *sudo raspi-config*. This will take you to the Pi config menu.
- K. Select item 3 and enable boot directly to desktop. Save the changes and reboot.
- L. The Pi should now reboot directly to the desktop and first run D-Rats Repeater followed by D-Rats.