

Creating a Basic NAS with Ubuntu Linux

(Rev 2)

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Introduction

This set of instructions will show you how to create a basic public (to your LAN) file server using [Ubuntu Linux](#). This allows you to turn any aging PC into a pretty nice Network Attached Storage (NAS) device.

There are many options out there for building a basic NAS server, one notable one being [FreeNAS](#). I chose Ubuntu because it is flexible, popular, and widely supported. I also like Ubuntu because of its simplicity in configuration — it is dead easy to set up a very basic Linux server with minimal cruft installed. As an added bonus, Ubuntu Server 8.04 LTS (Long Term Support) will be supported until 2013.

As you become more familiar with Ubuntu Linux, you can easily add new services to your server. One day you might want to set up a local web server. Another time, you might want to delve into a local proxy cache server or a gateway.

When I first started my blog, I used my local Linux server to learn the ins and outs of Wordpress, Apache, and MySQL. I still use it to test out new features before I apply them to my real blog.

Why use Linux for a NAS?

These days, consumer-grade NAS devices are available at your local Best Buy, so why would you want to build your own?

For one, you have much more latitude in creating your shared drives when working with a Linux file system than you might have with a NAS device¹.

For example, a slightly geeky Linux beginner can easily figure out how to mount several hard drives at different mount points in the root file system and then use symbolic links to piece together a shared drive from multiple physical devices or make several shared drives from one physical drive.

On my first file server I had two physical devices, mounted as such:

```
/mnt/samba1  
/mnt/samba2
```

On the **samba1** drive, I had a **common** folder with the following subfolders:

```
/mnt/samba1/common/Books  
/mnt/samba1/common/Photos  
/mnt/samba1/common/Music
```

¹ However, you can be certain that any off-the-shelf NAS device you can buy is running some lightweight version of Linux.

The **Music** folder was growing in size and was dangerously close to exceeding the size of the disk drive. Unfortunately, it seemed that I couldn't move it anywhere since all of the Windows computers in the house had a shared drive that pointed to **common**. People's Winamp libraries would break if I changed the path to the music folder tree.

After some thought, I realized that it was trivial to completely reconfigure the physical locations of the folders while retaining the same apparent logical configuration to the Windows machines.

I first moved the MP3s to **samba2**.

On **samba2**, I now had the users home drives as well as all of the MP3s:

```
/mnt/samba2/home  
/mnt/samba2/common/Music
```

I then used symbolic links in another directory to dummy up how I wanted the shared drive to really look:

```
lrwxrwxrwx 1 root root 24 Sep 28 2006 Books -> /mnt/samba1/common/Books/  
lrwxrwxrwx 1 root root 24 Sep 28 2006 Music -> /mnt/samba2/common/Music/  
lrwxrwxrwx 1 root root 25 Sep 28 2006 Photos -> /mnt/samba1/common/Photos/
```

This allowed me to present all of my media on a single share that really is stored on multiple hard drives.

This is just one example of the flexibility that a Linux file server gives you. With a little bit of work, you can have **cron** jobs running Perl scripts that do wonderful things with your files while you sleep.

For example, I have a **cron** job that goes through my MP3 collection at night and changes ownership and group and makes all of them read-only. This makes it so that any rogue Windows machine cannot change an MP3 after the first day it was uploaded. No matter how much the Windows viruses want to do so, they will be blocked by the Linux file permissions.

I have another **cron** job that runs every hour looking for new MP3s and runs a relatively compute-intensive open-source volume normalization tool² on them so that my entire library has normal volume levels without me lifting a finger.

² MP3Gain: <http://mp3gain.sourceforge.net/>

Preparation

Configure the PC

Choose a nice slightly older Intel PC for your installation.

Make sure you have removed everything that you will ever need from the hard drive.

Since we are building a server, it would be nice if the server would automatically restart after a power failure. This is usually an option in modern BIOS setup.

Go in to your PC's BIOS setup screen (totally hardware dependent how you do this) and make the following two changes:

- Configure the machine to restart after power failure.
- Configure the boot order to boot from CD first.

Plug the PC into your network. The machine will need Internet access during the installation. You will need to use a wired connection — a wired connection is always there, while wireless requires much setup before the connection is available.

Warning!

Make sure you are connecting your new server to a router that provides a firewall with network address translation (NAT). Almost all modern home routers, such as Linksys, Netgear, and D-Link provide this protection.

Until you understand Linux security better, do not connect your new server directly to a cable modem attached to the Internet. Though we are creating a minimal Linux server, with few unneeded services, we don't want to run the risk of some cracker or worm compromising our system before it even gets going.

Download the Software

On another machine, download the Ubuntu Server CD image and burn the ISO image to CD (most disk burner programs have a “burn disk from ISO image” option).

Get Ubuntu Server 8.04 LTS³ from here:

<http://www.ubuntu.com/getubuntu/download>

³ Time marches on, so perhaps when you read this, Ubuntu Server will be up to a higher version. Make sure you get “Server Edition” and “LTS” for “Long Term Support.” These steps can still be used as a guide to follow as you install your version.



Figure 1: Select these options

The downloaded ISO image is half a gig.

Warning!

In the following steps, you will be wiping every last trace of data from your machine's hard drive. It will cease to be a Windows machine, and all data will be lost. Make sure you have the correct machine and you have backed up all data you care to keep.

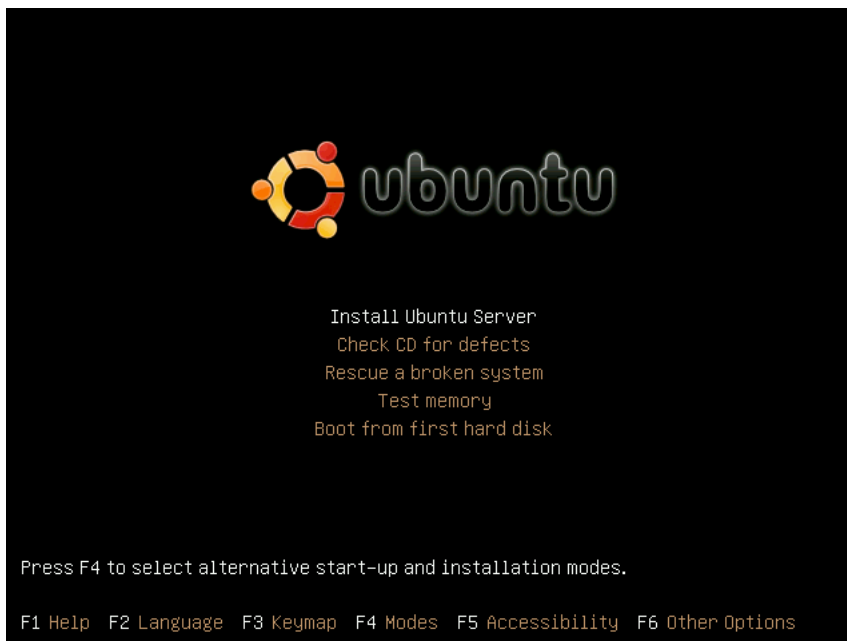
Installation (15 minutes!)

Screen: Language Selection



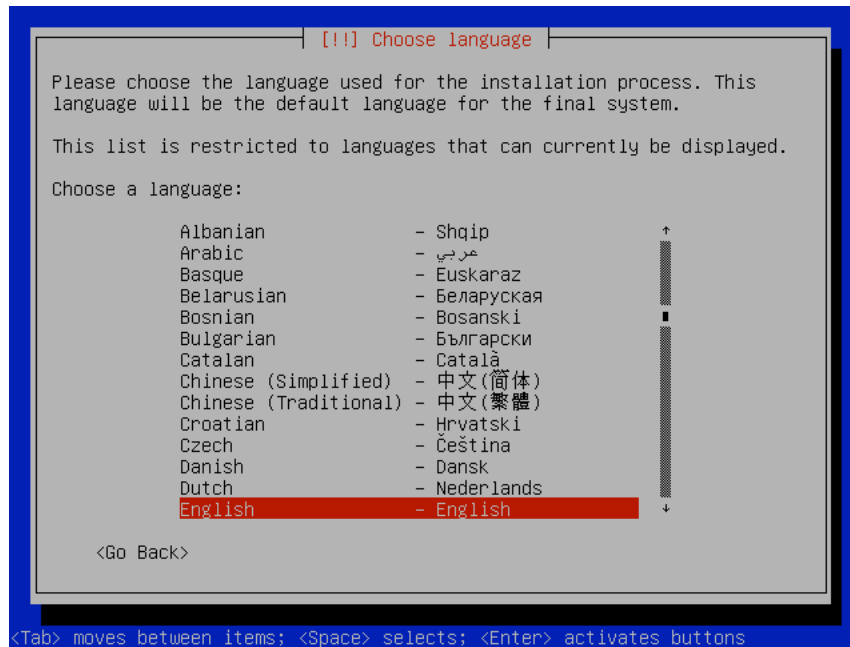
Choose **English** and hit the ENTER key.

Screen: Boot



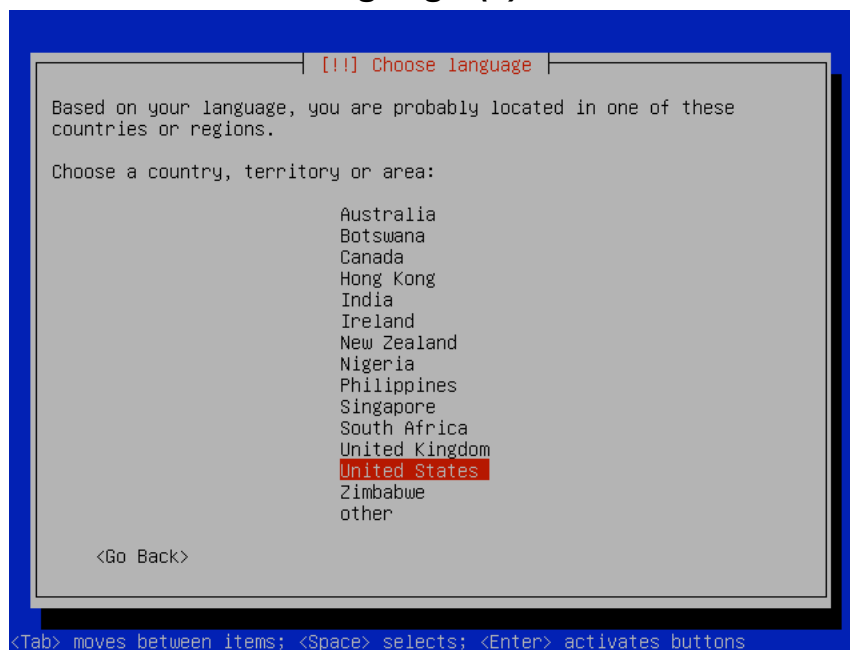
Use arrow keys to select **Install Ubuntu Server** and hit ENTER.

Screen: Choose language

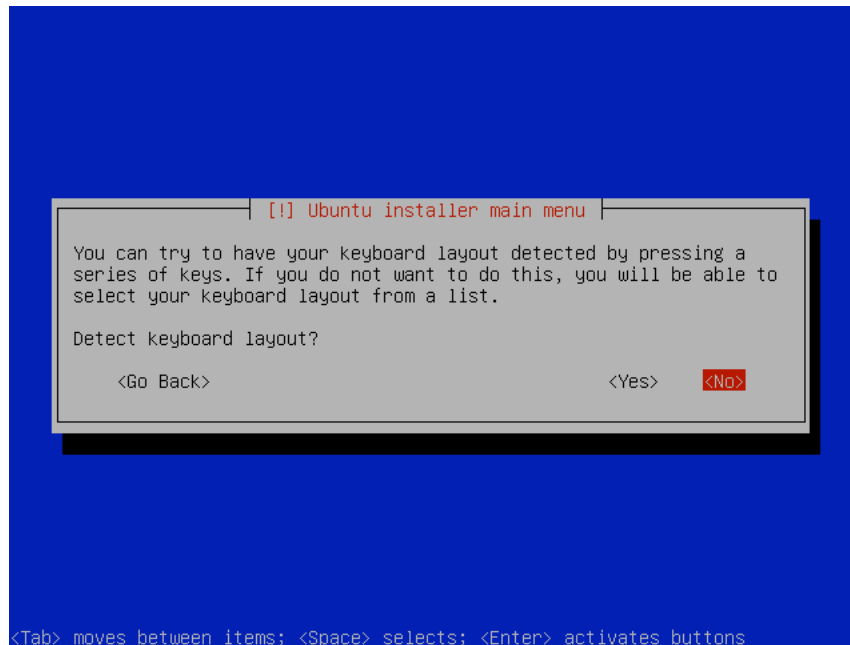


Choose **English** and hit ENTER.

Screen: Choose language (2)

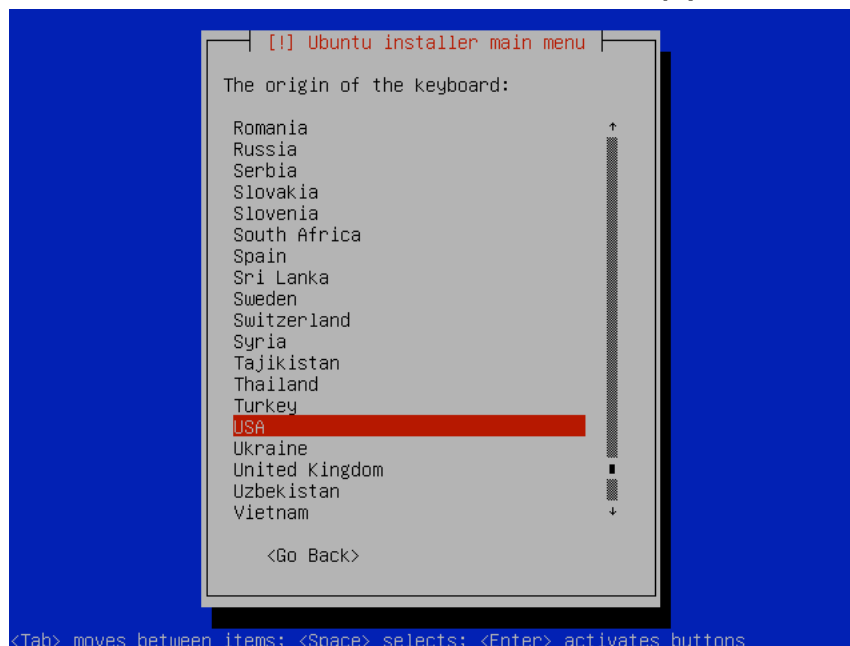


Choose **United States** and hit ENTER

Screen: Ubuntu installer main menu

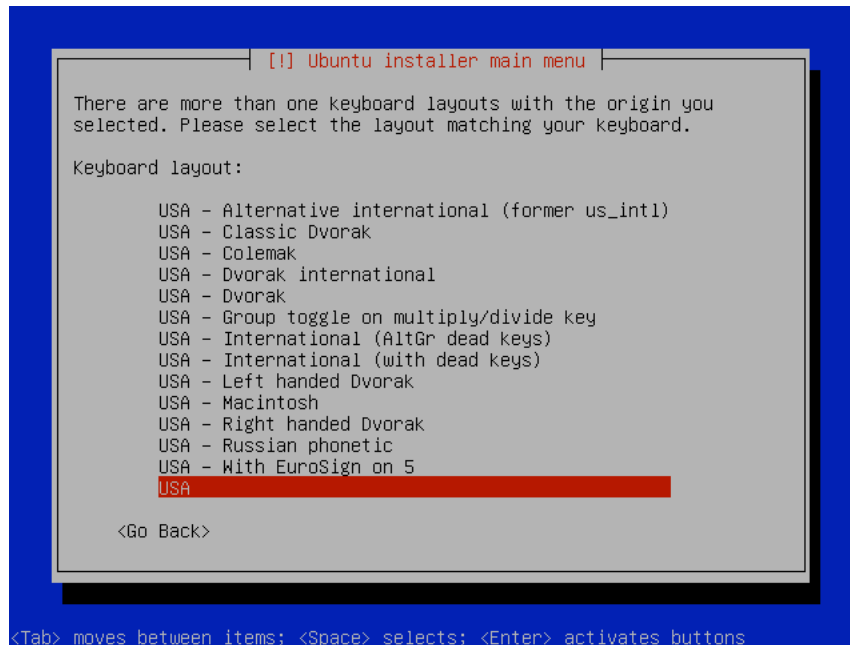
At this point, you could follow the instructions to have Ubuntu detect your keyboard, but I tried it and it is more trouble than it's worth, asking you a dozen questions about funny characters on your keyboard.

Assuming American English, use the arrow keys to select **No** and hit ENTER.

Screen: Ubuntu installer main menu (2)

Use the arrow keys to choose **USA** and hit ENTER.

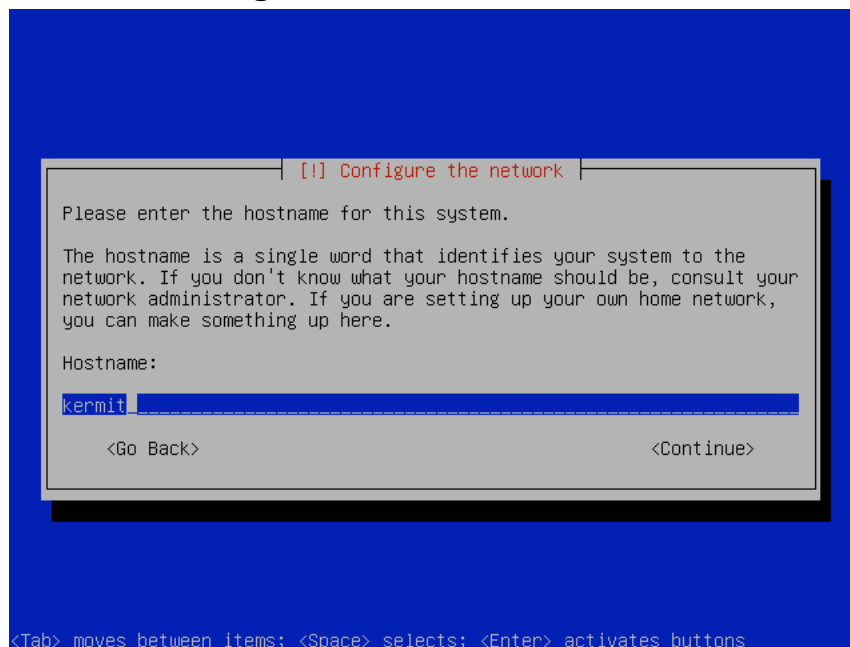
Screen: Ubuntu installer main menu (3)



Again, use the arrow keys to select **USA** and hit ENTER.

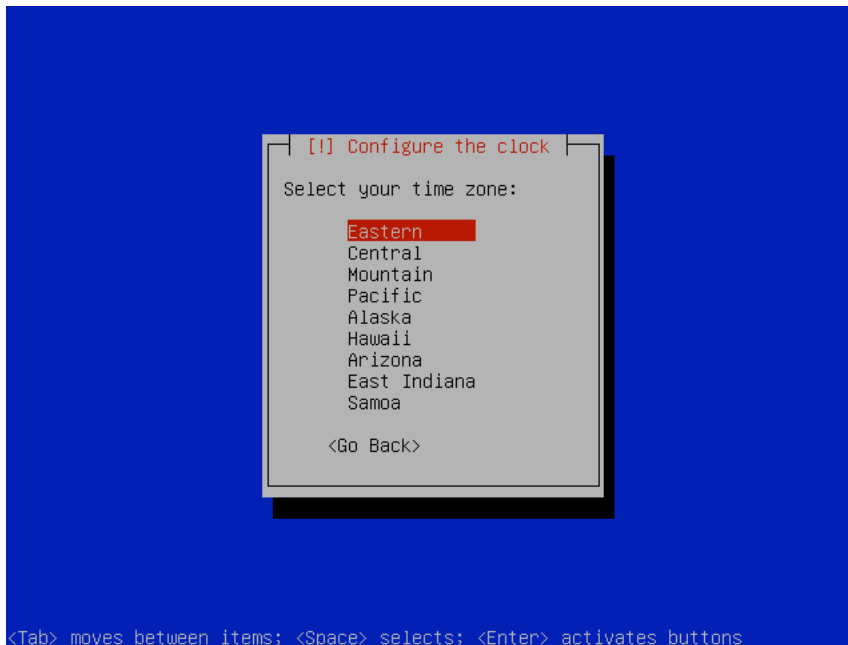
At this point you will see a progress bar on the screen as Ubuntu checks your hardware setup and loads drivers.

Screen: Configure the network



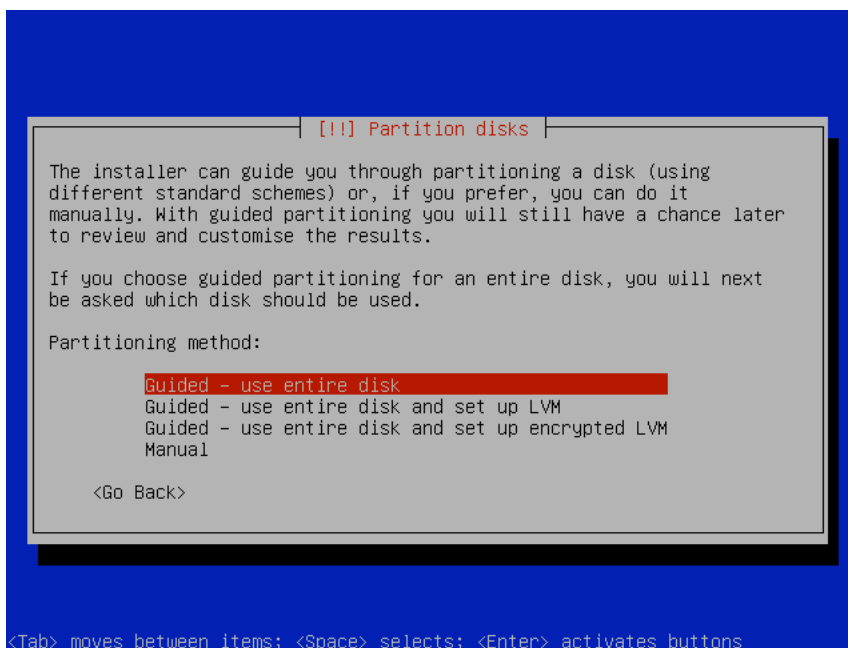
Change the default server name **ubuntu** to something useful and hit ENTER. I have entered **kermit** here. My machine will appear as **kermit** on my network.

Screen: *Configure the clock*



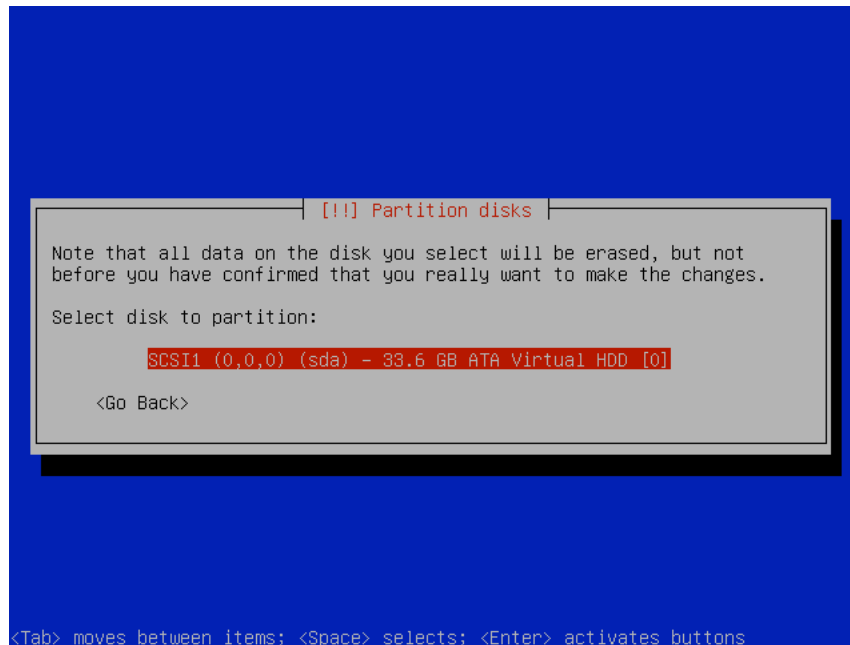
Choose your time zone and hit ENTER.

Screen: *Partition disks*

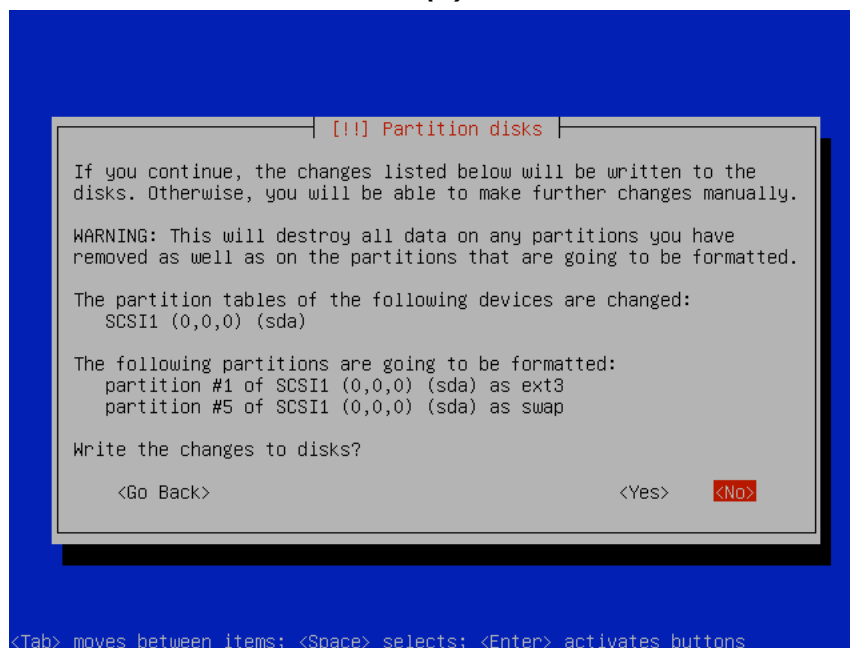


You may have more options shown on this screen if there are old partitions on the machine.

Select **Guided – use entire disk** and hit ENTER.

Screen: Partition disks (2)

Choose the first option. (In this example, I am running the build inside a virtual machine).

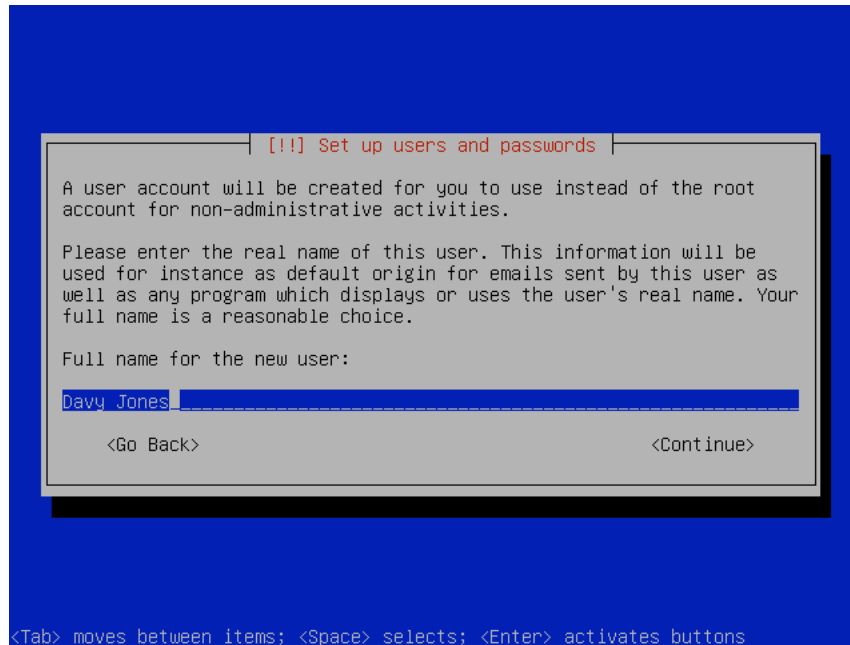
Screen: Partition disks (3)**Warning!**

This is it! You are erasing the entire hard drive!

Use the arrow keys to select **Yes** and hit ENTER.

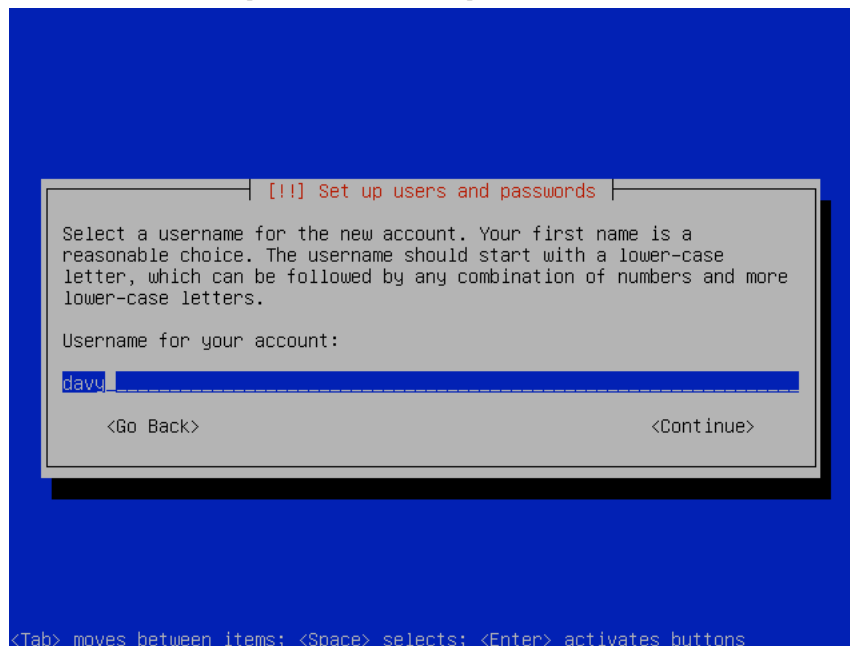
At this point, the Ubuntu base system will be installed on your hard drive. This may take anywhere from ten minutes to over a half hour, depending on the age of your machine.

Screen: Set up users and passwords



Following the instructions on the screen, enter your full name (or the name you want to use) and hit ENTER.

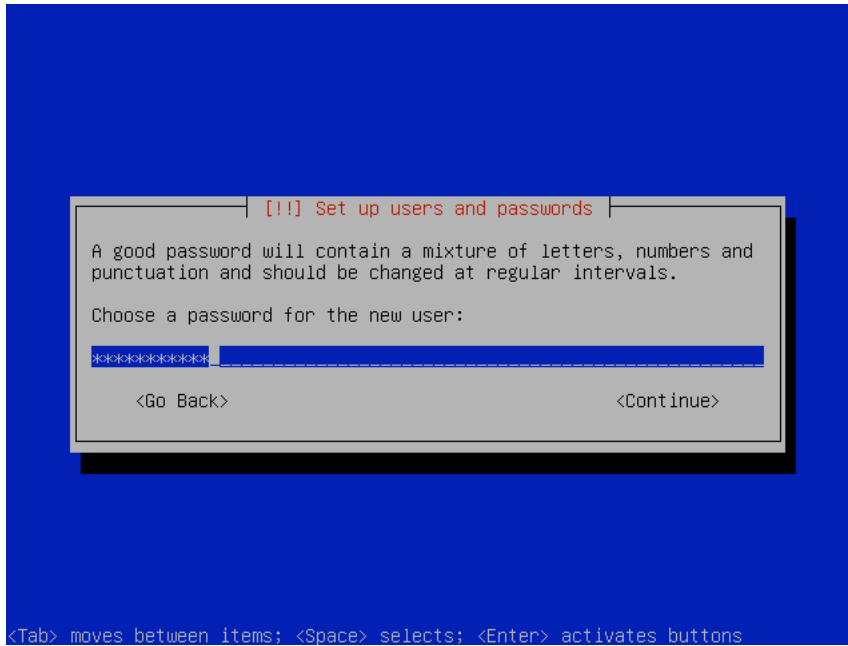
Screen: Set up users and passwords (2)



The installer will provide a default short username for you. If you want to change it, please be sure to follow the username format rules shown on the screen.

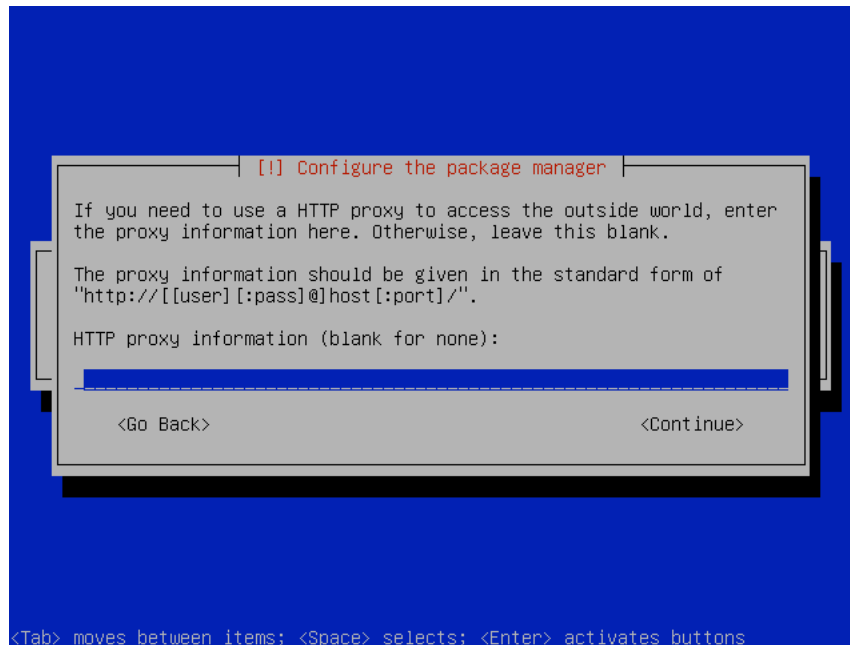
Hit ENTER to go on.

Screen: Set up users and passwords (3,4)



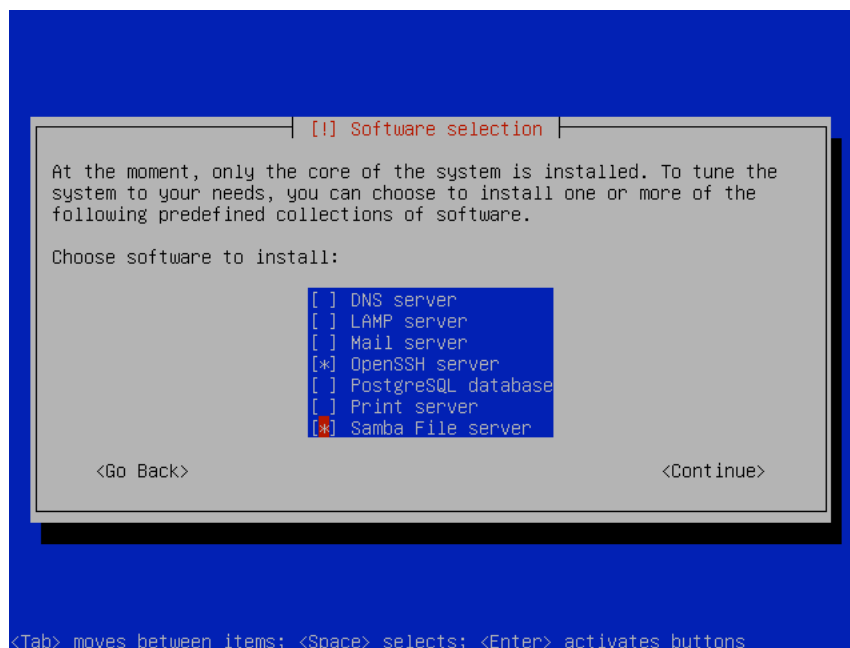
Enter a password for your new account, hit ENTER, and then enter the same password a second time to confirm.

Screen: Configure the package manager



Unless you have to use a special HTTP proxy server, just leave this blank and hit ENTER.

Screen: Software selection

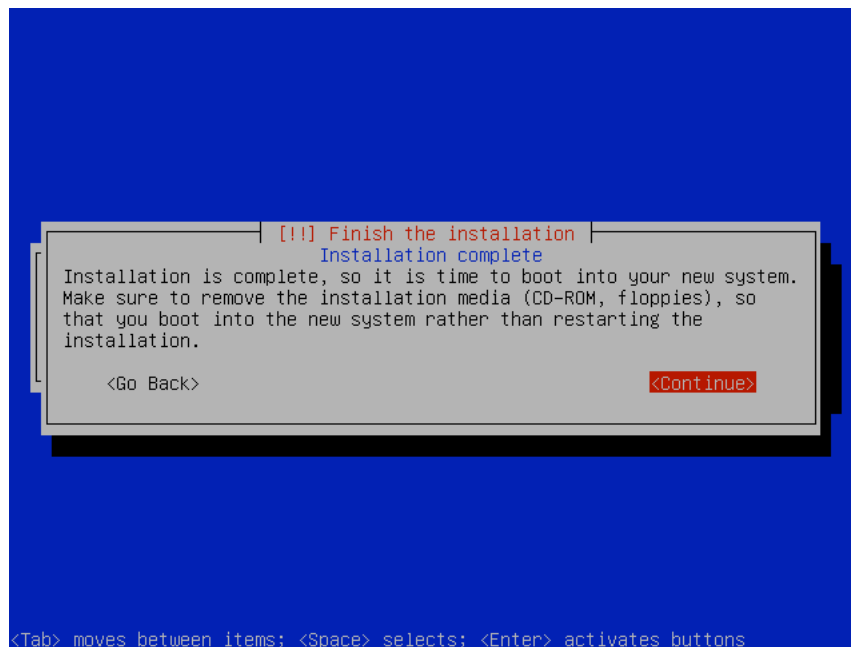


We are going to set up a basic Network Attached Storage device, so we need to install Samba.

In addition, we want to hide the machine, sans monitor and keyboard, in a closet somewhere, so we will need to install OpenSSH so we can use a SSH client from Windows or OS X to connect to the server.

Use the arrow keys and the SPACE bar to select **OpenSSH server** and **Samba File server** and then hit ENTER.

Screen: Finish the installation



Congratulations!

You are done with the installation.

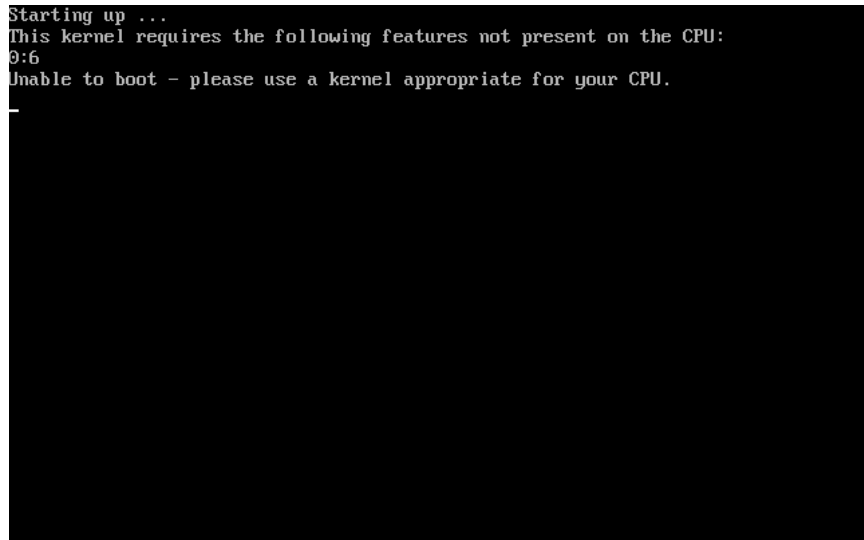
Maybe.....

Now, remove the CD-ROM, use the arrow keys to select **Continue**, and hit ENTER.

If your server boots up, eventually showing you a login prompt, then all is good. Skip the next section and go on to **Configuring The Server** on page 22.

If you get a scary **Unable to boot** message or you enter a reboot loop, then read the next section.

Screen: Bootup Error



```
Starting up ...  
This kernel requires the following features not present on the CPU:  
0:6  
Unable to boot - please use a kernel appropriate for your CPU.  
-
```

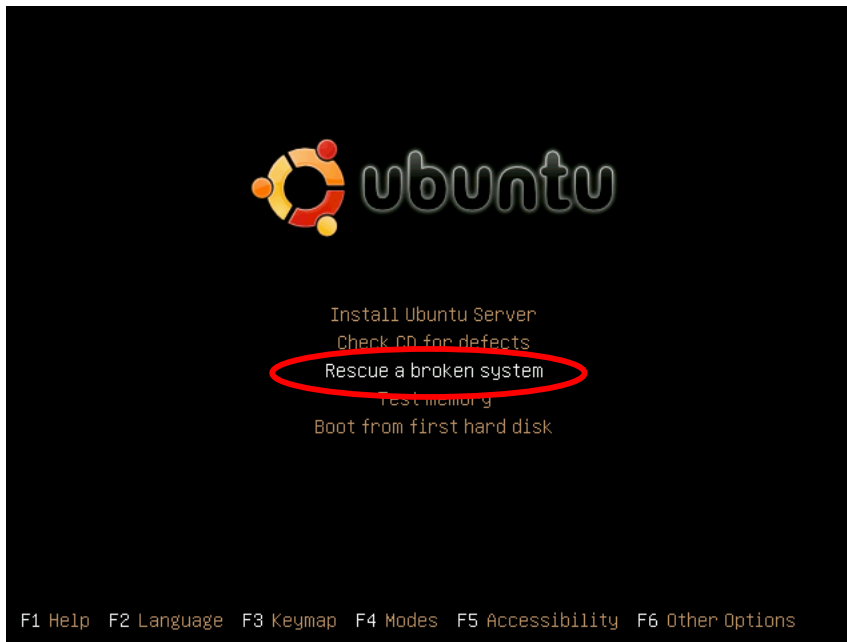
This is what I saw when I tried to boot. A bit of research showed that this is a result of the Ubuntu server kernel being compiled for a system with “PAE” support.

According to [Wikipedia](#), this stands for “Physical Address Extension” and is used for accessing memory beyond 4GB.

Since we are making a teeny tiny NAS server, we can swap out the fancy kernel for a version that doesn’t have the fancy extensions, and nobody will notice (except you, because the new one will actually work).

Now, boot from the CD

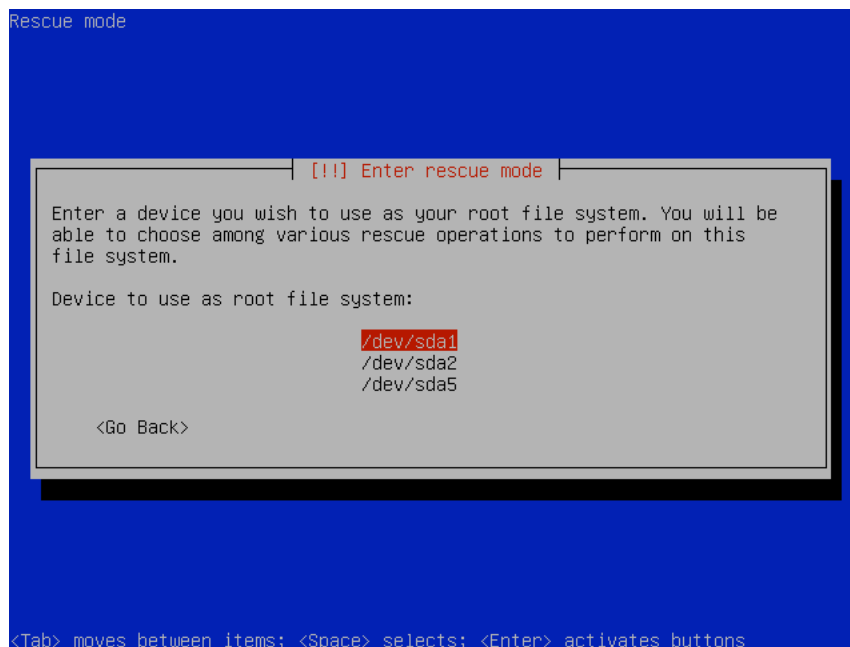
Screen: Boot



Use the arrow keys to select **Rescue a broken system** and hit ENTER.

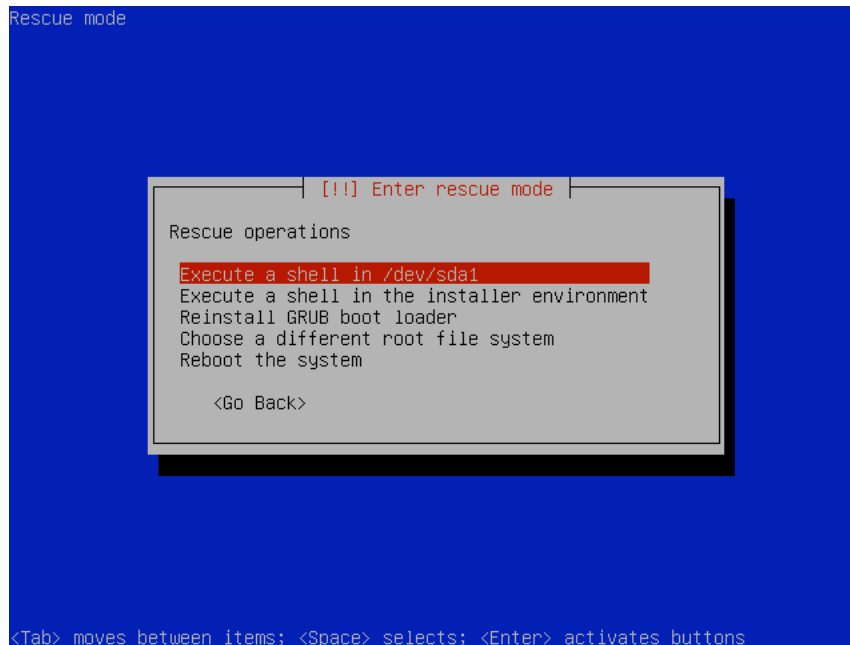
Now go through the language and keyboard prompts, answering them as before. You will also have to provide your machine name and the time zone.

Screen: Enter Rescue Mode



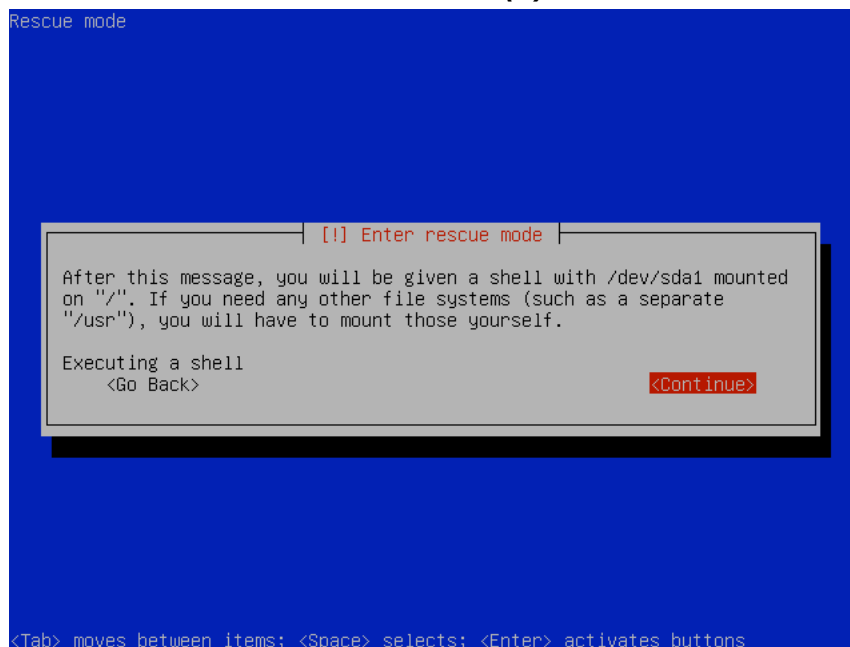
Choose **/dev/sda1** and hit ENTER.

Screen: Enter rescue mode (2)



Choose the first **Execute a shell** option and hit ENTER; it will have the same device name that you chose in the previous screen.

Screen: Enter rescue mode (3)



Choose **Continue** and hit ENTER.

Now you will be at a # prompt.

Type the following:

```
# apt-get update
```

Wait for operation to complete. You may have to hit ENTER to get the # prompt back.

```
# apt-get install linux-386
```

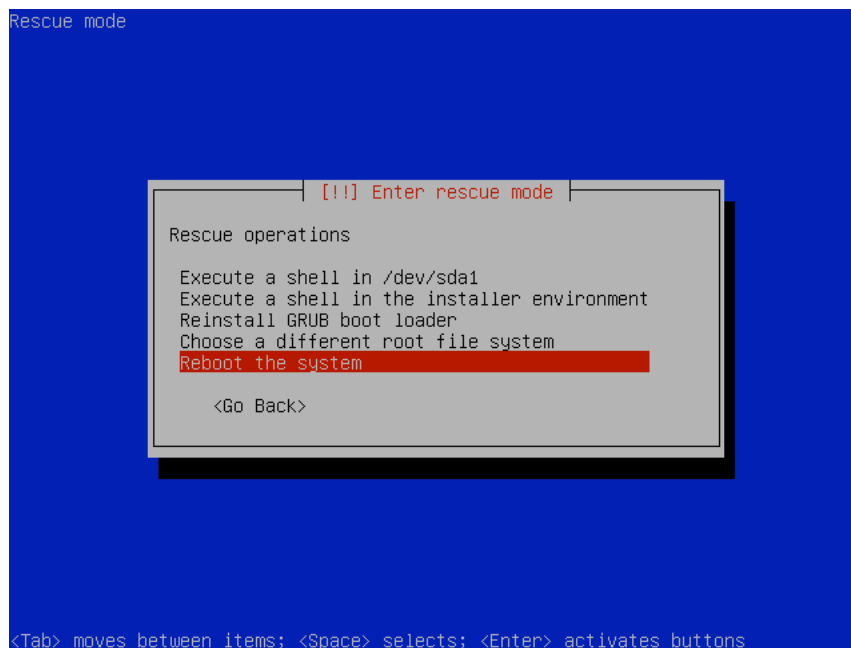
You will be prompted (Y/n) before the install. Hit ENTER to accept the default and do the install. Wait for the operation to complete.

```
# apt-get remove linux-server
```

You will be prompted (Y/n) before the removal. Hit ENTER to accept the default and do the removal. Wait for the operation to complete.

```
# exit
```

Screen: Enter rescue mode (4)



Remove the CD-ROM from the drive.

Use the arrow keys to select **Reboot the system** and hit ENTER.

Configuring The Server

Some Ubuntu Basics

All work is done using the admin account that you created when you installed your system. No one typically logs into Ubuntu as **root**.

In order to do something that requires root privileges, use the **sudo** command.

For example, to perform a shutdown, do this:

```
$ sudo shutdown -h now
```

Ubuntu will prompt you for your password and then perform the task.

Install applications using **apt-get** command:

```
$ sudo apt-get install samba  
$ sudo apt-get install openssh-server
```

You can find the IP address of the new server by using the **ifconfig** command.

Restart **samba** (or any other service) by calling its startup script with full path:

```
$ sudo /etc/init.d/samba restart
```

All startup scripts live under the same path: **/etc/init.d**

Basic file editing can be done with either **vi** (if it suits you) or the much simpler and more friendly **nano** editor.

For example, to edit the **samba** configuration file (a task that requires **root** privileges):

```
$ sudo nano /etc/samba/smb.conf
```

Booting your New Server

Here's what you get after restart and login⁴.

⁴ You might see some strange error messages flying by as the server starts up. Some of these are meaningful, while others may be harmless. For example, I had installed my server inside a virtual machine, so when the startup process tried to change the system clock, the VM software didn't allow that, and Ubuntu showed an error saying that the hardware system clock couldn't be changed.

```

* Starting kernel log daemon... [ OK ]
* Starting OpenBSD Secure Shell server sshd [ OK ]
* Starting Samba daemons [ OK ]
* Starting the Winbind daemon winbind [ OK ]
* Starting deferred execution scheduler atd [ OK ]
* Starting periodic command scheduler crond [ OK ]
* Running local boot scripts (/etc/rc.local) [ OK ]

Ubuntu 8.04.2 kermit tty1

kermit login: davy
Password:
Last login: Sun Feb 15 00:19:08 EST 2009 on tty1
Linux kermit 2.6.24-23-386 #1 Sun Jan 25 23:32:00 UTC 2009 i686

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

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To access official Ubuntu documentation, please visit:
http://help.ubuntu.com/
davy@kermit:~$ _

```

First update the directory of available packages:

```
$ sudo apt-get update
```

Now upgrade the basic system packages:

```
$ sudo apt-get upgrade
```

```

Unpacking replacement initscripts ...
Setting up linux-image-2.6.24-23-server (2.6.24-23.48) ...
Running depmod.
update-initramfs: Generating /boot/initrd.img-2.6.24-23-server
Not updating initrd symbolic links since we are being updated/reinstalled
(2.6.24-23.46 was configured last, according to dpkg)
Not updating image symbolic links since we are being updated/reinstalled
(2.6.24-23.46 was configured last, according to dpkg)
Running postinst hook script /sbin/update-grub.
Searching for GRUB installation directory ... found: /boot/grub
Searching for default file ... found: /boot/grub/default
Testing for an existing GRUB menu.lst file ... found: /boot/grub/menu.lst
Searching for splash image ... none found, skipping ...
Found kernel: /boot/vmlinuz-2.6.24-23-386
Found kernel: /boot/vmlinuz-2.6.24-23-server
Found kernel: /boot/mentest86+.bin
Updating /boot/grub/menu.lst ... done

Setting up linux-ubuntu-modules-2.6.24-23-server (2.6.24-23.37) ...
update-initramfs: Generating /boot/initrd.img-2.6.24-23-server

Setting up initscripts (2.86.ds1-14.1ubuntu45.1) ...

davy@kermit:~$ _

```

At this point, we can log in using **ssh** from a more comfortable machine.

In order to connect via **ssh**, you will need to know your new server's IP address. Use the **ifconfig** command for this.

```
$ ifconfig
```

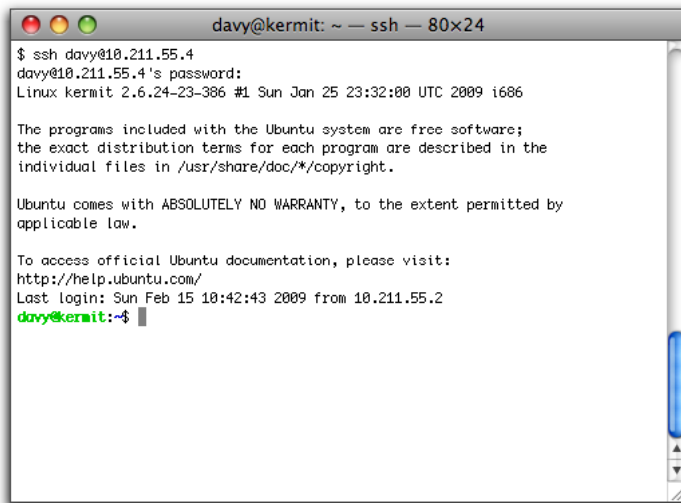
Look for a line saying **inet addr:** under **eth0**.

That line should show your machine's IP address (probably issued by your router).

If you are a Windows user, you might want to use PuTTY:

<http://www.chiark.greenend.org.uk/~sgtatham/putty/>

If you are a Macintosh or Linux user, you can run the **ssh** command from within a terminal window.



Setting a Static IP Address

For any of the server configurations in this document you will likely want to set a static IP address. This is especially important for small-scale operations, like your home, where you likely don't have a fancy DNS setup and your DHCP server is built in to your hardware router.

Make sure you select an address that fits the following:

- It must be within the range of your network (typically 192.168.1.2 — 192.168.1.254).
- It must not be in use anywhere else in your network. This will cause you endless grief if overlooked.
- The address must not be in the range of addresses that your DHCP server uses to issue addresses.

Make a backup copy of the original **interfaces** file.

```
$ sudo cp /etc/network/interfaces /etc/network/interfaces.orig
```

Edit the interfaces file, shown in Listing 1, and make the changes shown in Listing 2.

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

```
# This file describes the network interfaces available on your system
```

```
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
auto eth0
iface eth0 inet dhcp
```

Listing 1: Original interfaces file

```
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
auto eth0
# Comment out original line
# iface eth0 inet dhcp
# Now add new lines for the static configuration
iface eth0 inet static
    address 10.1.10.150 # Your IP address
    netmask 255.255.255.0 # Keep this value
    network 10.1.10.0 # [same first three octets] . 0
    broadcast 10.1.10.255 # [same first three octets] . 255
    gateway 10.1.10.1 # [same first three octets] . 1
```

Listing 2: Modified interfaces file

Edit the **resolv.conf** file and set the name server address following Listing 3. This example is configured to use OpenDNS servers for naming.

```
$ sudo nano /etc/resolv.conf
```

```
# You can enter up to three lines of type "nameserver ip-address"
# Use your ISP name servers or one of the options below

# Use this section if you wish to use OpenDNS name servers
# (see www.opendns.com for details)
nameserver 208.67.222.222
nameserver 208.67.220.220

# Use this section if your router is configured as a name server
# This should point to your router gateway address
# nameserver 192.168.1.1
```

Listing 3: resolv.conf file

Since you are no longer using DHCP to request an address, you should disable the DHCP client. I recently set up an Ubuntu server with a static IP address, only to find that it had magically changed addresses in the middle of the night. This was due to a still-running DHCP client process.

The easiest way to permanently disable DHCP is to remove the client altogether:

```
$ sudo apt-get remove dhcp3-client
```

Finally, restart the network:

```
$ sudo /etc/init.d/networking restart
```

Setting Up Time Synchronization

If you are going to run a server of any kind, it will likely be running for hundreds of days. Indeed, when I run `uptime` on the MP3 file server machine I have running in the kids' closet, I get the following:

```
23:05:09 up 138 days, 23 min, 1 user, load average: 0.23, 0.06, 0.02
```

It looks like something must have happened 138 days ago — maybe someone tripped over the plug when they were digging into the back of the closet. Linux is robust. And this is an ancient Toshiba Infinia Pentium II 200mhz machine from 1997.

Anyway, you can imagine how important it is to have active time synchronization if you are going to have your dodgy old machine running for months at a stretch. You not only want your times to be consistent with other servers and with reality, but you want to avoid any strange jumps in time that may make logs difficult to interpret.

There are two basic tools for setting time on your server. The first one is a good way to get your server time set correctly right now.

Update your time on demand as such:

```
$ sudo ntpdate ntp.ubuntu.com
```

This is a nice way to set the clock accurately, and some people use a **cron** job to run this command daily to bring their clock back in line with the rest of the world.

The problem with this approach is that it can cause abrupt jumps in time, making logs look funny.

A more genteel approach is to use the **ntp** daemon.

```
$ sudo apt-get install ntp
```

This will obtain and configure the **ntp** daemon. This background process checks the time server regularly and applies tiny incremental changes to your system clock until it is in sync.

It is a good idea to perform the brute-force **ntpdate** method first before starting the **ntp** daemon. Otherwise the daemon may take a long time to bring the system clock in sync, and it might even give up if the clock is too far off.

Configuring the File Server

Backup Samba Configuration

Everything about Samba configuration is found in a single file called **smb.conf**. Make a backup copy of the original **smb.conf** file.

```
$ sudo5 cp /etc/samba/smb.conf /etc/samba/smb.conf.orig
```

Create Directories

For this basic configuration, we will create a directory for each public folder.

We will create two: **public** and **common**.

```
$ sudo mkdir /home/public
$ sudo chmod 777 /home/public/

$ sudo mkdir /home/common
$ sudo chmod 777 /home/common/
```

Configure Samba

Edit the Samba configuration file:

```
$ sudo nano /etc/samba/smb.conf
```

Replace everything with the following:

```
[global]
workgroup = MSHOME
server string = Kermit's Samba Server
encrypt passwords = yes
wins support = yes
local master = yes
domain master = no
guest account = nobody
disable spoolss = yes
security = share
guest ok = yes
guest only = yes
```

⁵ Again, everything you do on your server will need to be prefixed by the **sudo** command so that the command is executed with **root** privileges.

```
force user = nobody
force group = nogroup
create mask = 0777
directory mask = 0777

[common]
comment = Common Folder
path = /home/common
public = yes
writable = yes

[public]
comment = Public Folder
path = /home/public
public = yes
writable = yes
```

Listing 4: smb.conf

You can replace the workgroup with your own Windows workgroup. Likewise, you might wish to replace **Kermit's Samba Server** with something more appropriate.

Any time you modify this file, you should restart your Samba service:

```
$ sudo /etc/init.d/samba restart
```

You should now be able to see the shares on your Windows network. Go ahead and play around, creating folders from Windows and the like.

Important Notes

This is a very simplistic server. You can happily use it like it is, allowing your family to store homework or other things on folders in the shared area, visible to all machines in the house. If you want to do fancier things, such as give individual users personal network drives, you should do some investigation of Samba on the web.

This is not a backup solution. It simply provides a shared hard drive on your network, just as prone to failure as the one in your desktop machine. Make sure you have a backup solution in place. You might simply use a tool like Microsoft's SyncToy⁶ to copy files from the network drive to an external USB drive from time to time.

⁶ SyncToy:

<http://www.microsoft.com/prophoto/downloads/synctoybeta.aspx>

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