WHITE PAPER

Instant openMosix

How to build a working openMosix cluster without touching a compiler

CONTROL PAGE

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1   Overview

The openMosix community has provided numerous ways for new users to easily and rapidly build clusters. Unfortunately, for the community, there are those new users who want to test openMosix on their own terms but haven't the understanding required to do so. These users are often disheartened by their initial experience and turned away from openMosix, simply because of their own configuration faults.

For these users, this paper will provide a basic, step-by-step process for installing a working openMosix cluster, using only an off-the-shelf Linux distribution and two openMosix RPMs.

This build process will not require code modification or compiling, it will be repeatable, and will not require prior openMosix experience.

It is hoped that this document will help most new openMosix users to understand the openMosix node and cluster configuration in a "clean" environment, allowing them to help themselves – to adapt a working model to their own environments.

2   It is a little daunting

2.1   How do I build an openMosix cluster?

That is the question.

Despite the amount of public information available, it seems that there is no shortage of people who want to try-out openMosix, but are unable to fit the pieces together. While these people seem genuine in their desire to run openMosix, I have struggled to explain concepts, both on and off the public lists, to those with configuration issues, network issues, or a combination of both. In some ways I'm not surprised that these people are here. There is no single resource that offers a clear and systematic approach to building an openMosix cluster. However, I feel frustrated knowing that my efforts are not helping and I can't imagine how frustrating it must feel to be in this configuration limbo, where no-one seems able to help.

To contribute further to this problem, the current Linux kernel series is mature and well set within the 2.6 range. OpenMosix, on the other hand, has only beta versions of its software for the 2.6 kernels. New users rightly expect to use 2.6 kernel versions of the openMosix code for their current kernels. Those with enough knowledge to find and acquire the new code are often not equipped to deal with the issues and errors that come from running the beta kernel software.

It is against this backdrop of confusion and despair that I offer the following documentation. Designed to show anyone how to build an openMosix cluster from a tried-and-true Linux distribution, and with the current production openMosix packages, this installation procedure requires no software compilation.

2.2   What am I about to build?

This guide will take you through the installation of one PC, to the point that it is able to join your cluster as an openMosix node. The cluster constructed from this document can be as simple as two nodes joined via cross-over network cable, or as complicated as a LAN full of nodes with a router for greater network access. In either case, the LAN (or LAN segment) is regarded as being equivalent to a VLAN or a PVLAN – the intention being that all nodes in the cluster are situated within the same LAN segment (broadcast/multicast domain). For the purposes of this document, this architecture will be referred to as a "flat cluster network".

While more complicated architectures are possible, they are not supported by this document. An example of a more complicated architecture might be where groups of nodes, belonging to a single cluster, are found on differing LAN segments (LANs, VLANs or PVLANs), separated by one or many routers.

If you are having difficulty constructing a complicated architecture, then you should validate your basic cluster configuration against this document in a flat cluster network, before continuing.

The following diagram shows the flat cluster network architecture – note the minimum requirements;
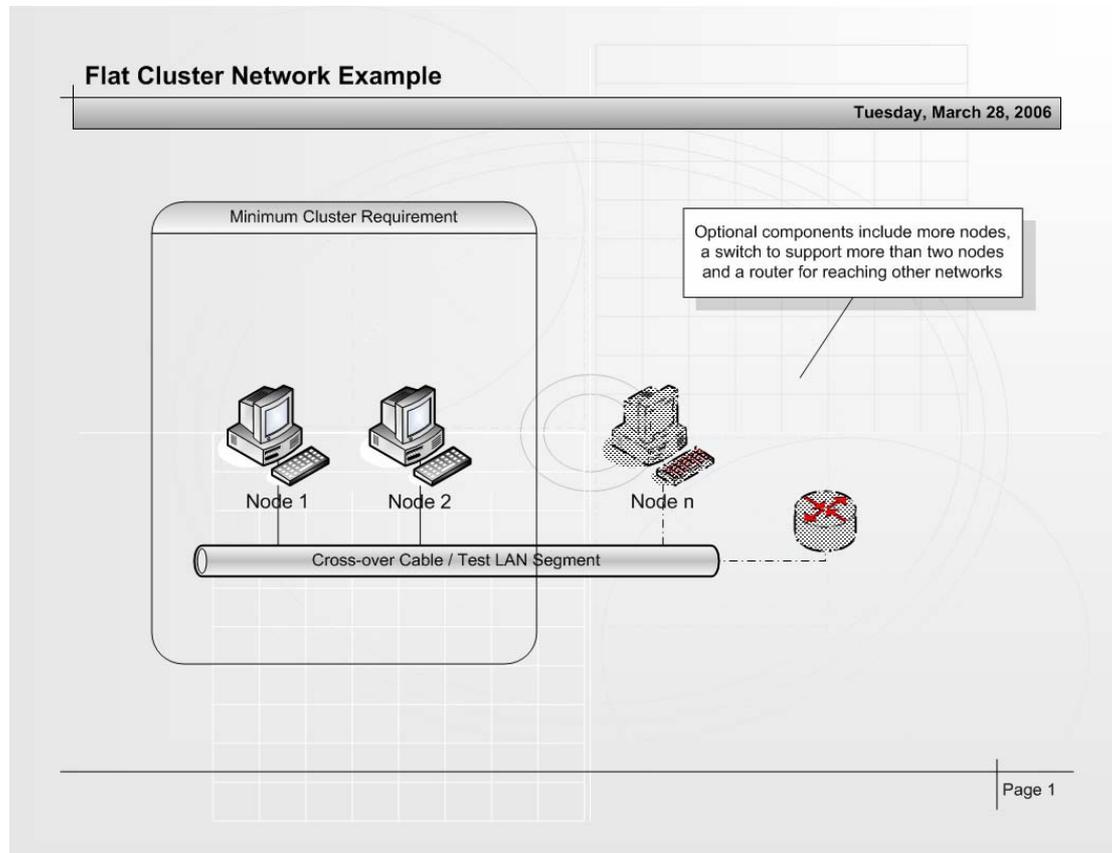
The IP addressing is arbitrary, but 192.168.100.0/255.255.255.0 will be used, with a default gateway of 192.168.100.1. PC's will be 192.168.100.11-192.168.100.254.

2.3   Hardware pre-requisites and preparation

Before you begin to install any software, check off the following list;

1. Working PC (X86 based), with at least 128Mbytes of RAM, 2Gbytes of disk capacity and a bootable CDROM drive (PC x 2)

2. CAT-5 cross-over cable (Cable x 1)

3. Blank CD-R (CD-R x 2)

4. Internet-connected PC with a CD burner.

You will also need a mechanism to put files on the new node. If you are using a cross-over cable network, then you will probably want to use the second CD-R to burn the files on, and transfer them. In the build process these were scp'd from another workstation on the same LAN.

3   Acquire the needed software

3.1   Download the Fedora Core 1 Operating System

There is no link from the Fedora Core home page to the Fedora Core 1 (Yarrow) download page. Fedora Core 1 is required as it is the latest Fedora Core OS to have a 2.4 kernel.

Visit the Fedora Core 1 (Yarrow) download page. In your web browser, perform the following.

Action	`Browse to` `http://download.fedora.redhat.com/pub/fedora/linux/core/1/`

This will display the Fedora Core 1 download site.
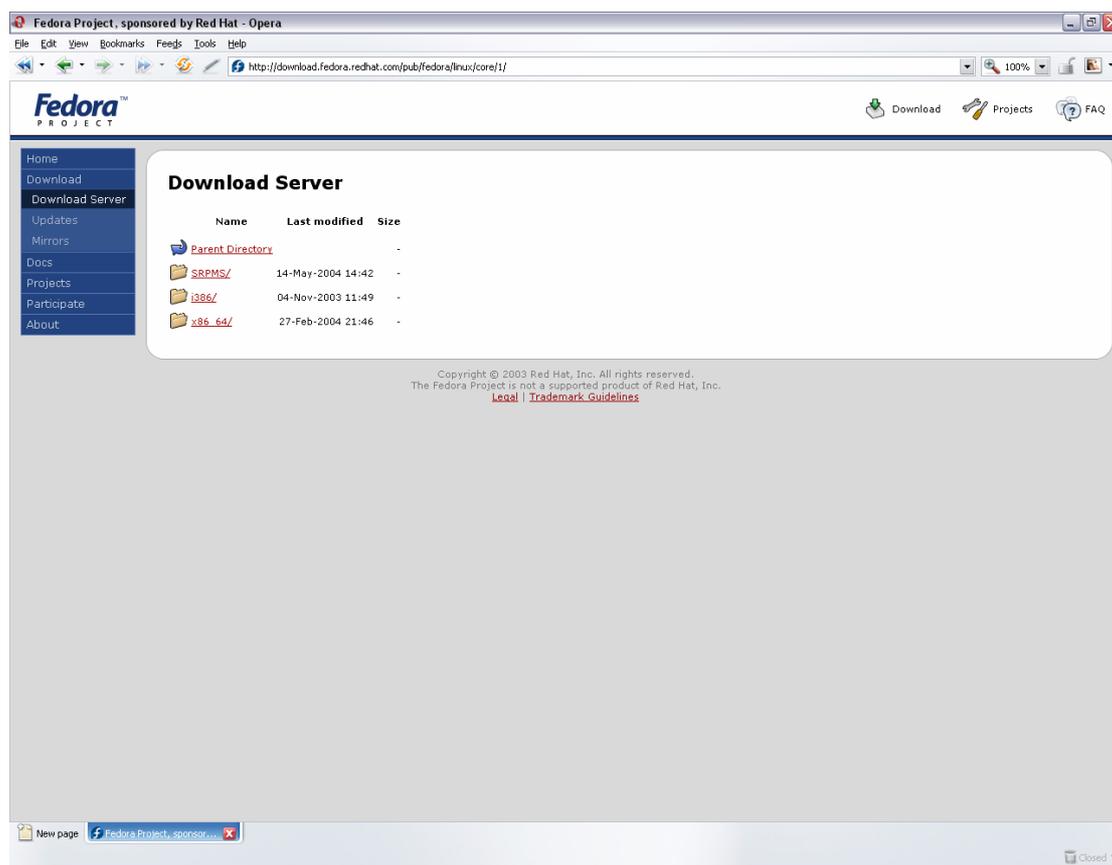
Select the i386 version.

Action	`Click "i386"`

This will display the Fedora Core 1 (Yarrow) Intel-386 architecture version download options.
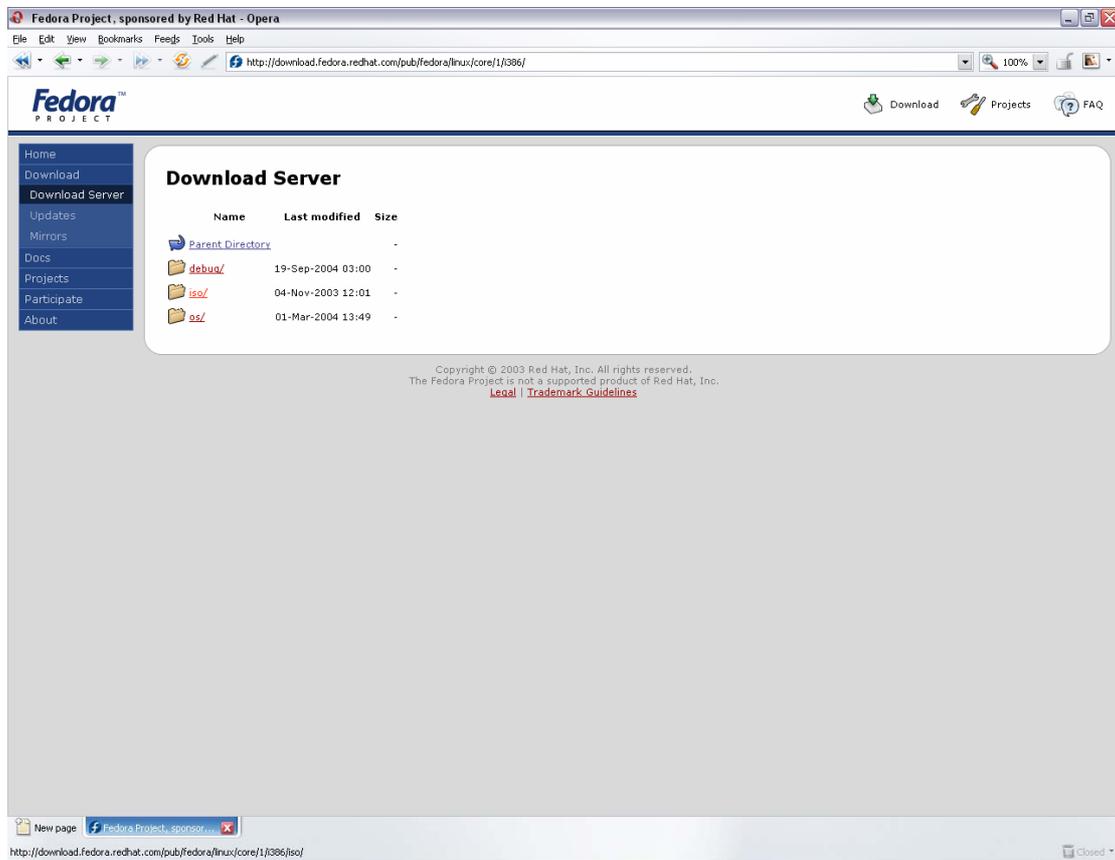
Select the ISO version.

Action	`Click "iso"`

This will display the Fedora Core 1 (Yarrow) Intel-386 CDROM images that are available for download.
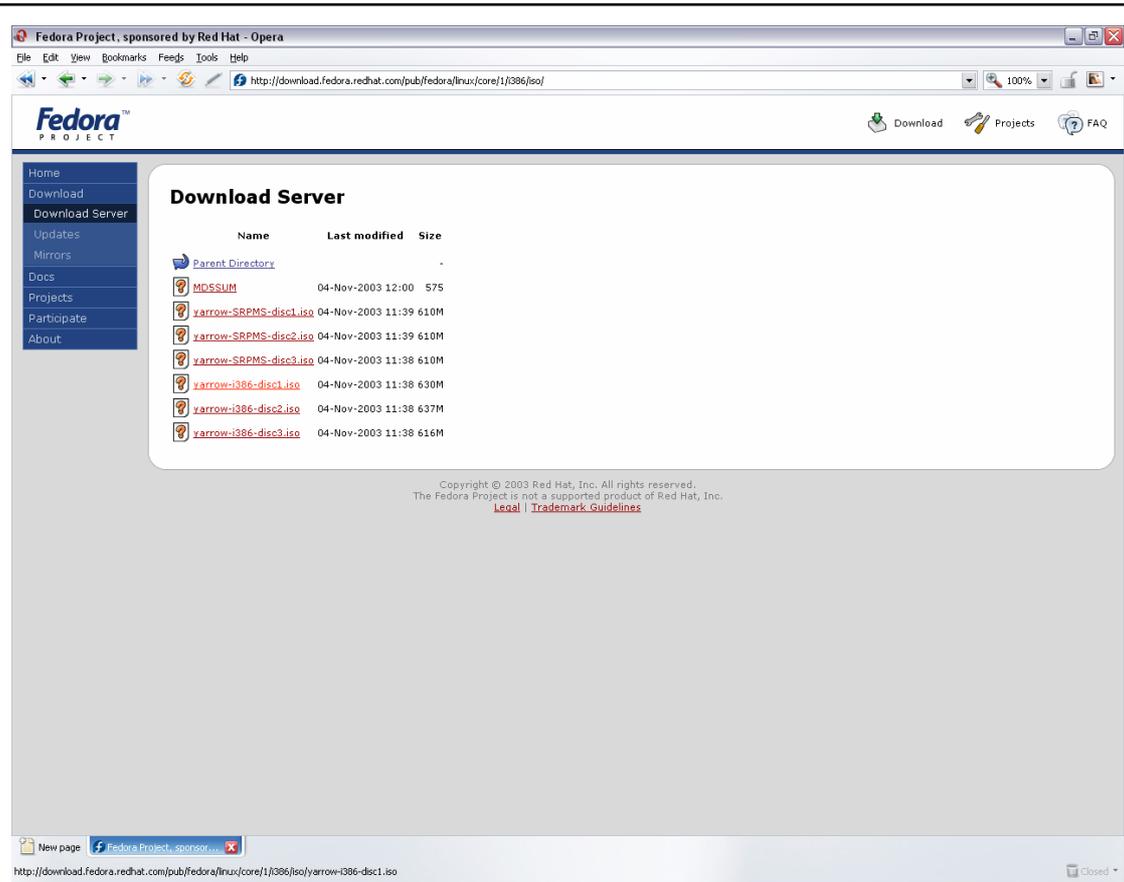
Select the yarrow-i386-disc1.iso, to download the first Fedora Core 1 CD.

Action	Click "yarrow-i386-disc1.iso"

Your browser download manger should then take control of the download;
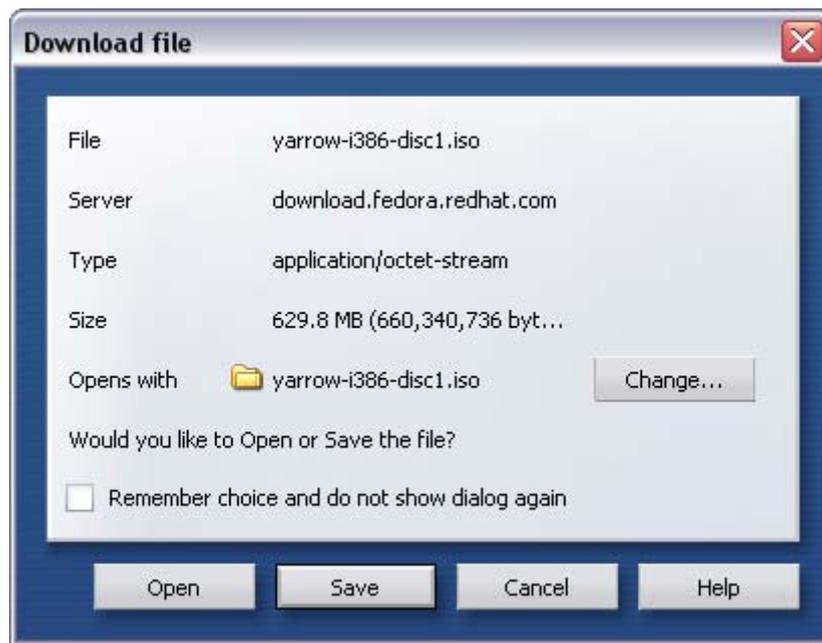
Action	Click "Save" to save the download to disk

The download manager should then retrieve the file from the Internet and store it locally.
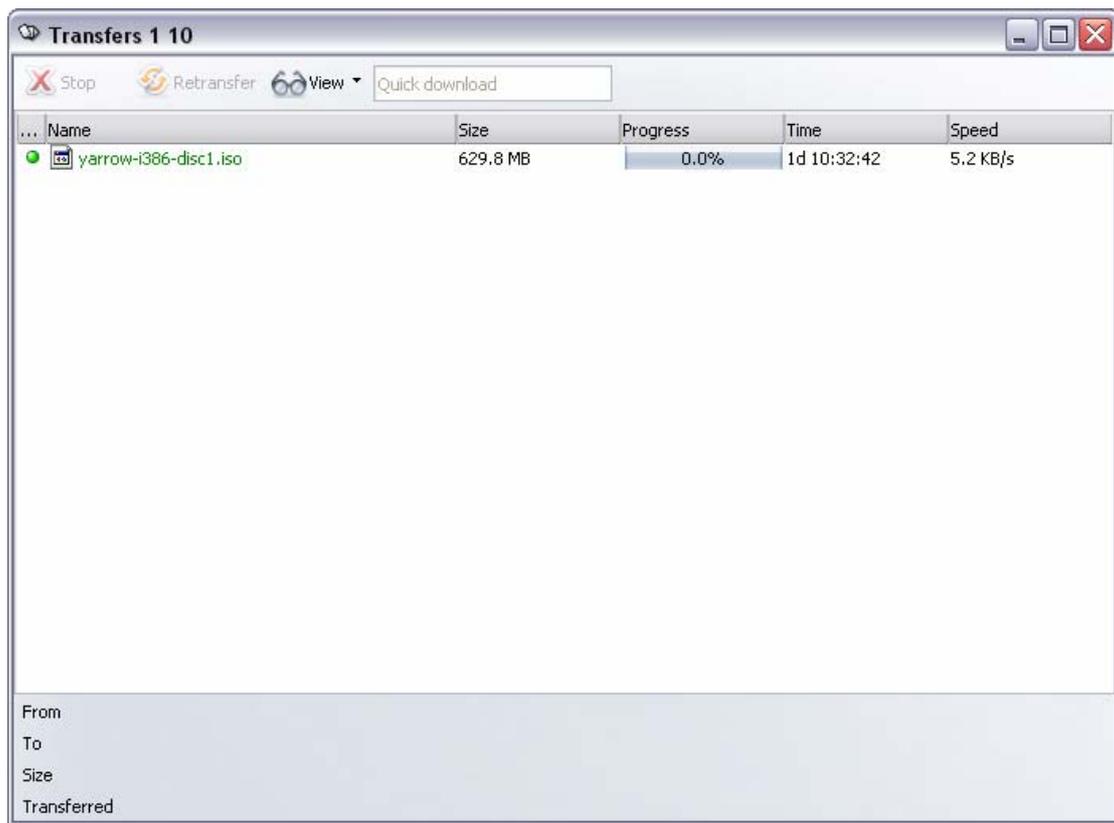
This may take some time, depending on your Internet connection and available bandwidth.

Allow this download to complete before moving on to section four (4).

Note that only the first CD is required to successfully complete the installation described in this document.

3.2   Download the openMosix kernel package

Visit the openMosix home page. In your web browser, perform the following.

Action	Browse to http://www.openmosix.org/

This will automatically redirect to the openMosix SourceForge page.
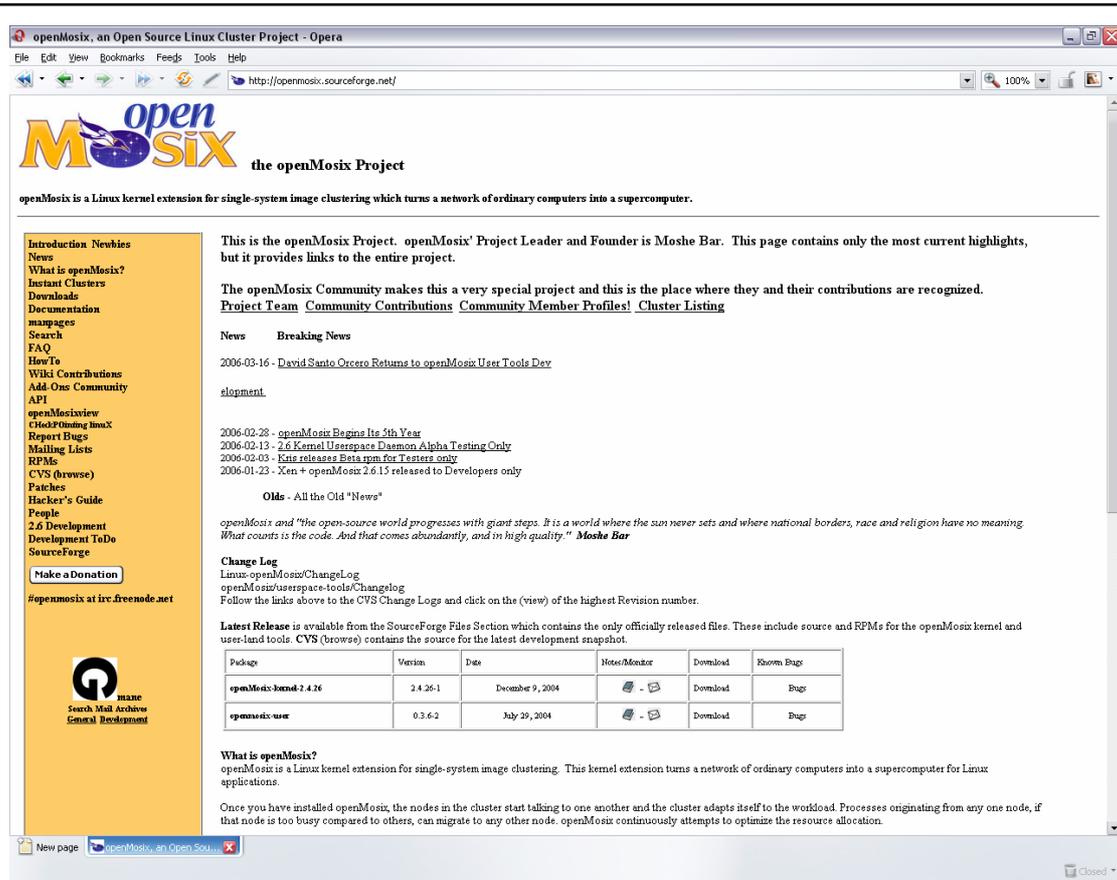
About half-way down that page, you will see the "Latest Release" table. Select the "Download" link for the openMosix kernel.

Action	Click "Download" for openMosix-kernel-2.4.26 (version 2.4.26-1)

This will take you to the openMosix project downloads page, and automatically open the kernel package to show the kernel package options.
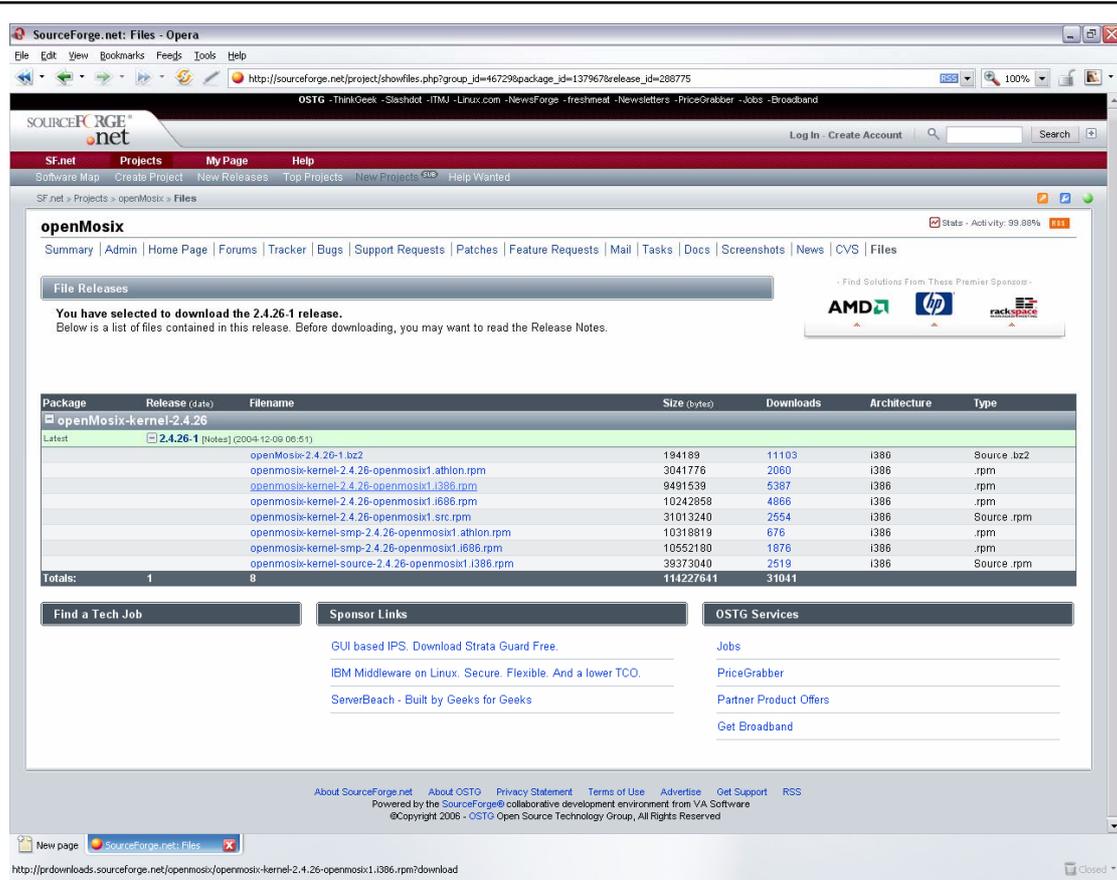
The kernel package that you require is openmosix-kernel-2.4.26-openmosix1.i386.rpm.

Action	Click "openmosix-kernel-2.4.26-openmosix1.i386.rpm"

You should then be presented with a list of available download locations.

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How to build a working openMosix cluster without touching a compiler
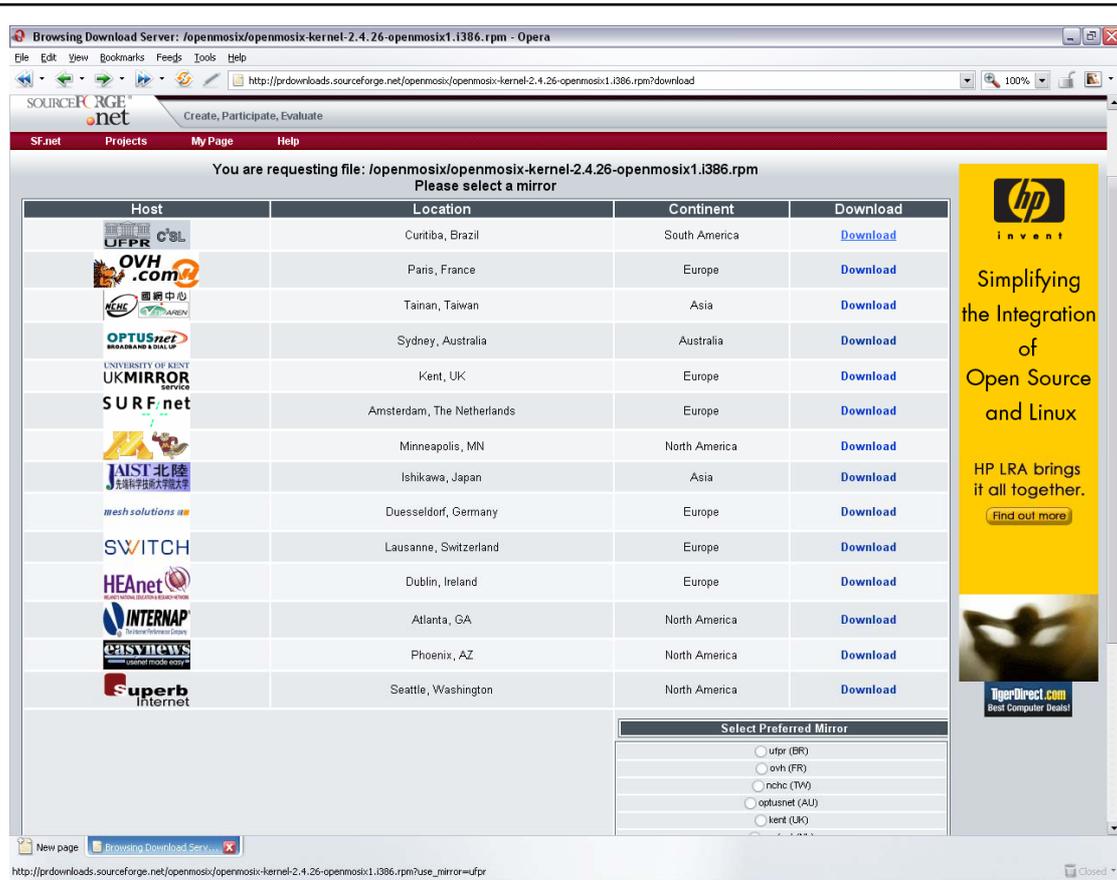
Select an appropriate location. In the example, the first location was selected.

| **Action** | Click "Download" for the closest or fastest location |

The download page should be updated to reflect the link that will be used to download the kernel package.

The page should auto-refresh to download the file. Your browser download manger should then take control of the download;
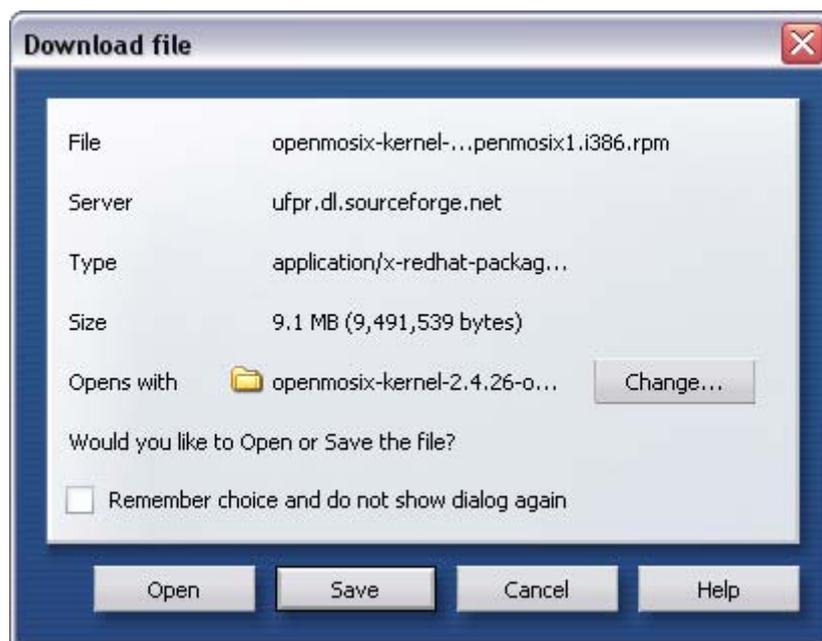
Action	Click "Save" to save the download to disk

The download manager should then retrieve the file from the Internet and store it locally.
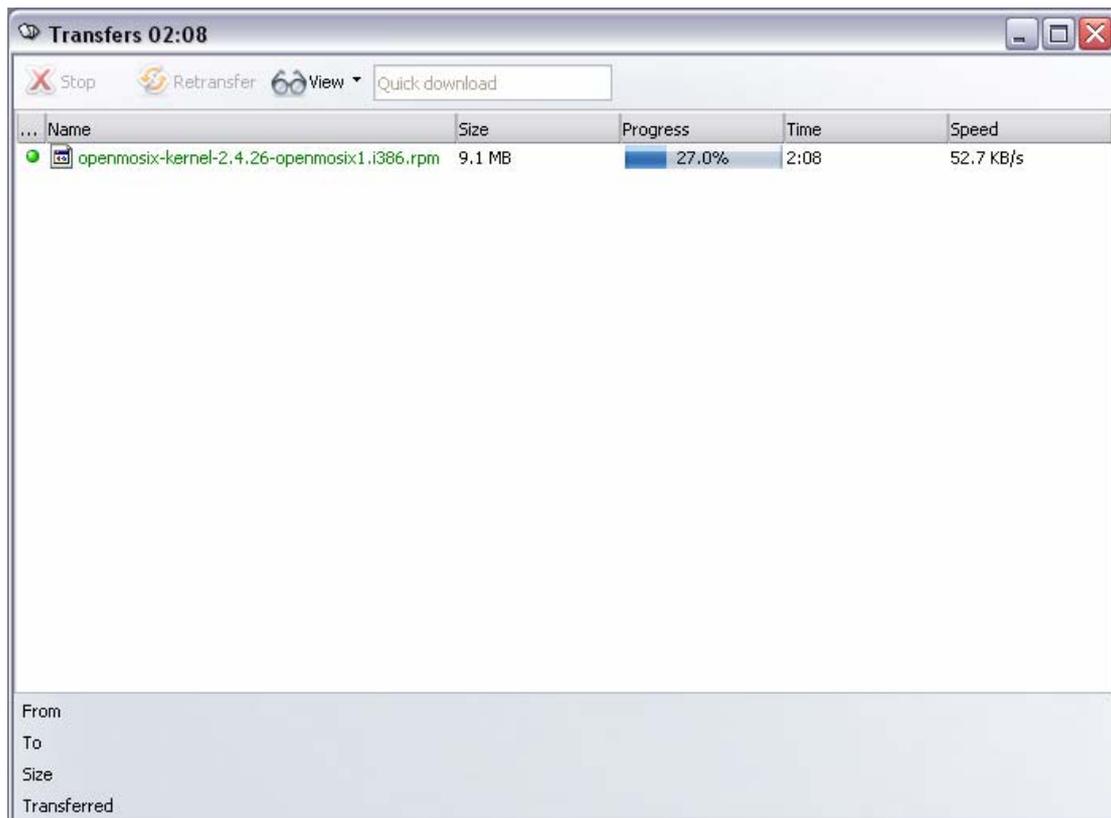
Allow this download to complete before moving on to section four (4).

3.3   Download the openMosix tools package

Return to the openMosix home page. In your web browser, perform the following.

Action	Browse to http://www.openmosix.org/

This will automatically redirect to the openMosix SourceForge page.

About half-way down that page, you will see the "Latest Release" table. Select the "Download" link for the openMosix tools.

Action	Click "Download" for openMosix-user (version 0.3.6.2)

This will take you to the openMosix project downloads page, and automatically open the user (tools) package to show the tools package options.
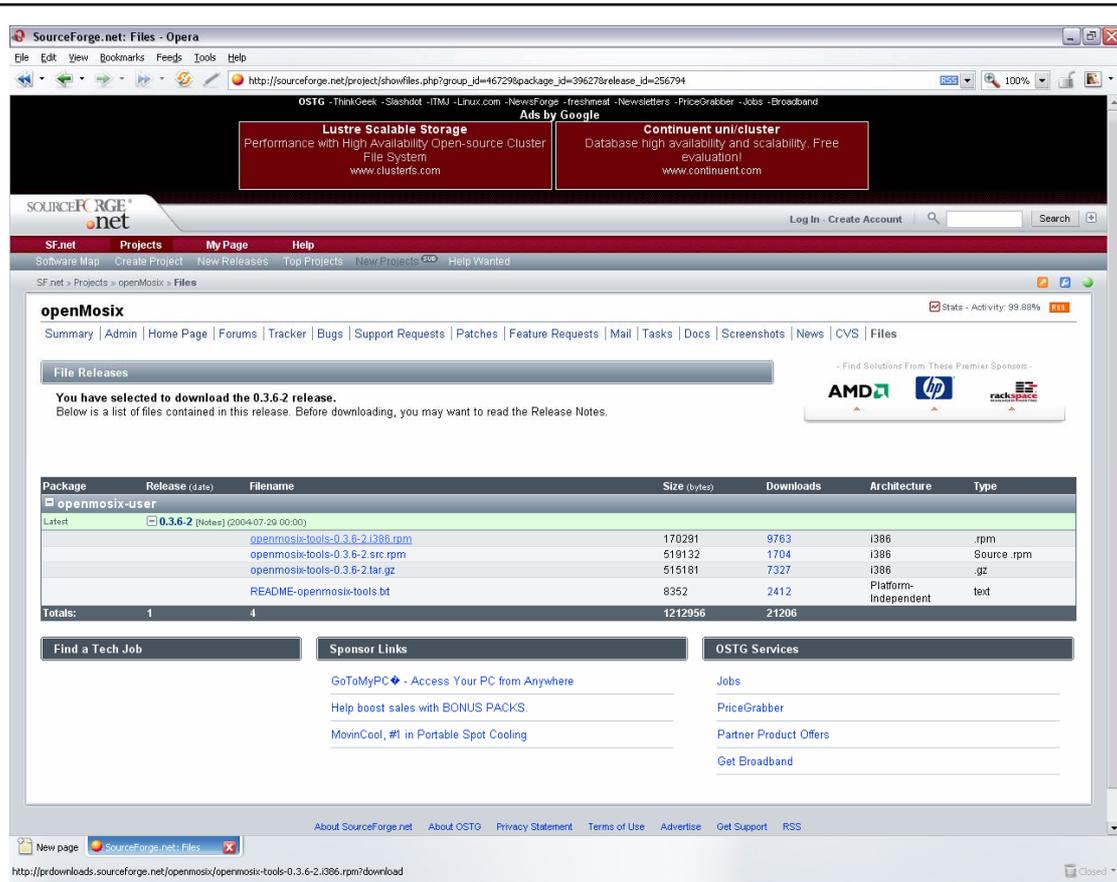
The tools package that you require is openmosix-tools-0.3.6-2.i386.rpm.

Action	Click "openmosix-tools-0.3.6-2.i386.rpm"

You should then be presented with a list of available download locations.

Select an appropriate location. In the example, the first location was selected.

Action	Click "Download" for the closest or fastest location

The download page should be updated to reflect the link that will be used to download the tools package.
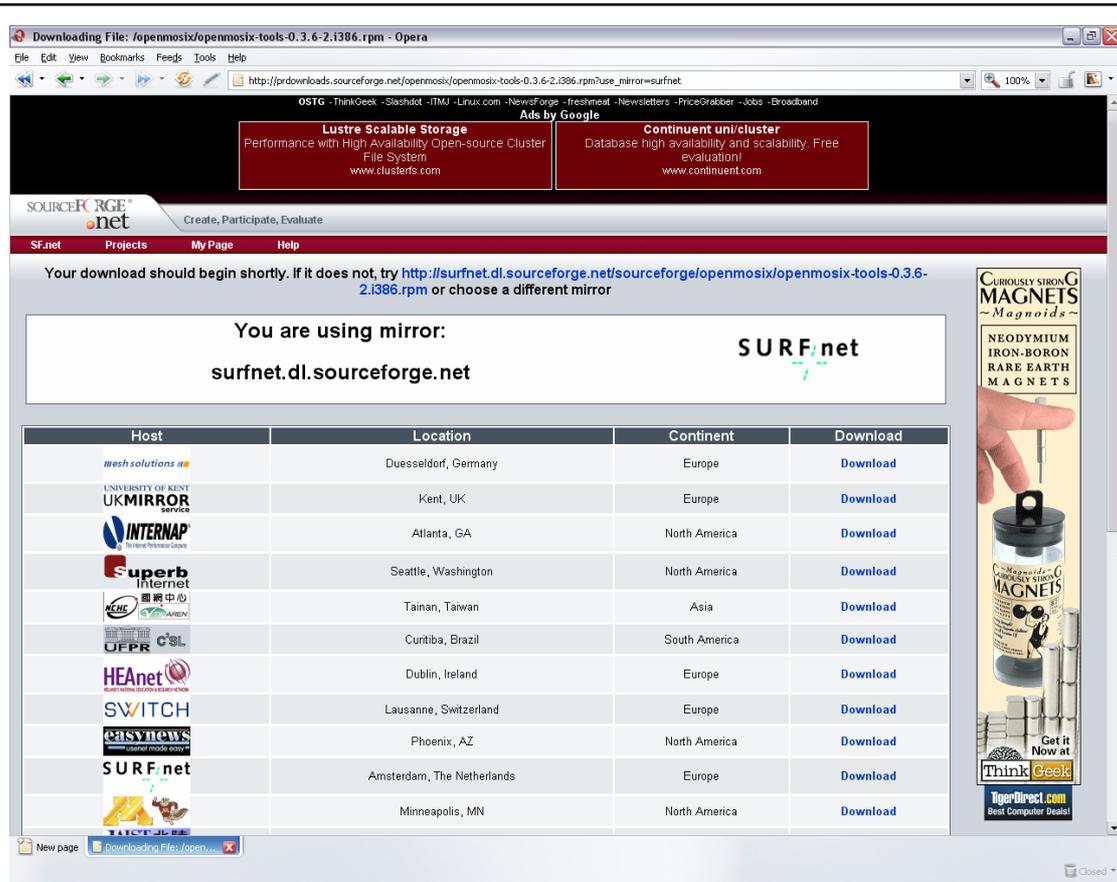
The page should auto-refresh to download the file. Your browser download manger should then take control of the download;
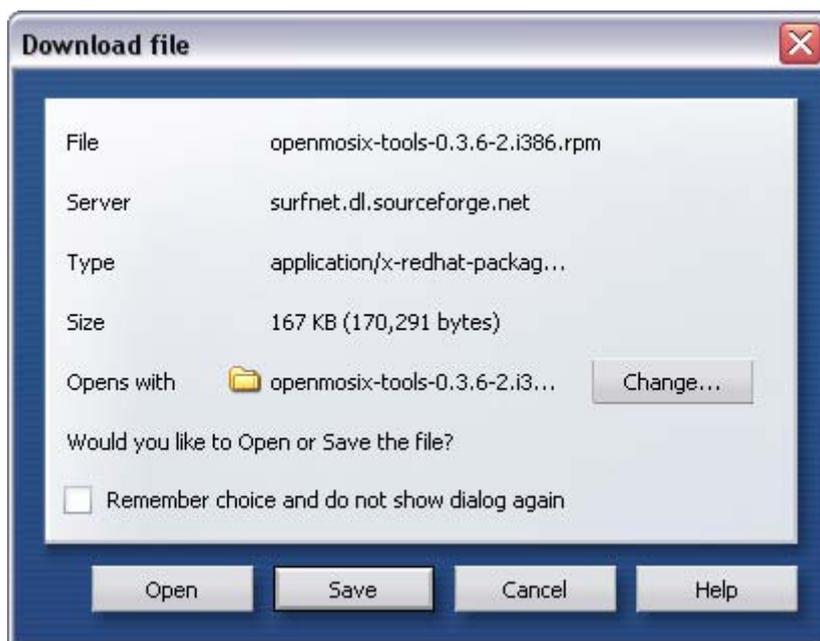
Action	Click "Save" to save the download to disk

The download manager should then retrieve the file from the Internet and store it locally.
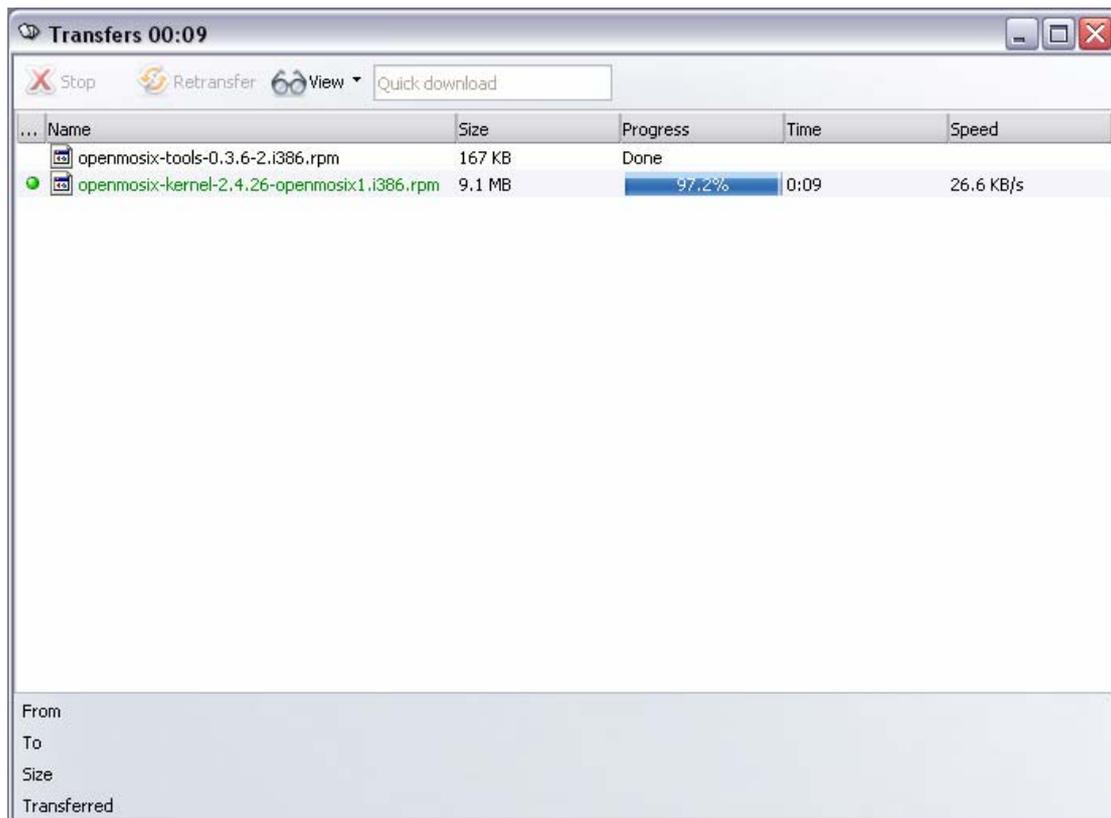
Allow this download to complete before moving on to section four (4).

3.4   Burn the software to CDROM

Depending on the operating system and CD utilities that you have available to you, there are a number of ways to burn this content to CDROM – these will not be described here.

Ensure that the Yarrow ISO image is burnt to the first disc (as a whole disk image).

Action	Burn "yarrow-i386-disc1.iso" as a whole disk image, to a CD-R

Then burn the two openMosix files to the second disc.

Action	Burn "openmosix-kernel-2.4.26-openmosix1.i386.rpm" and "openmosix-tools-0.3.6-2.i386.rpm" to the second CD-R

4   Install and configure a node

4.1   Boot to the first Yarrow CD

Insert the Yarrow (Fedora Core 1) CD into the CDROM drive of the computer to be built as the new node. Boot the computer.

Action	Insert the Yarrow CD into the PC, and then boot from the CD

The PC will boot to the following screen.
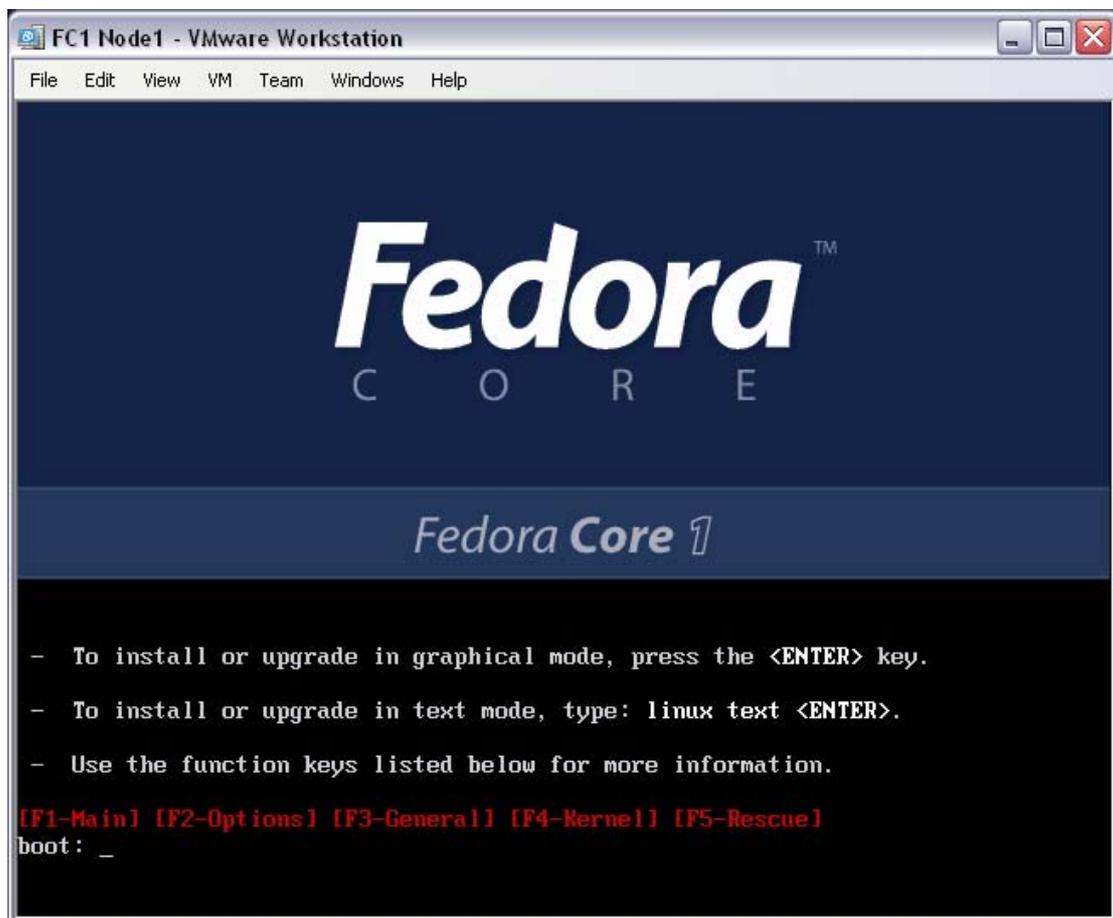
The OS installation will be performed as a "text mode" installation. To install RedHat's Fedora Core 1 in this mode, boot with option "linux text".

Action	At the CD boot prompt, enter "linux text" and press enter
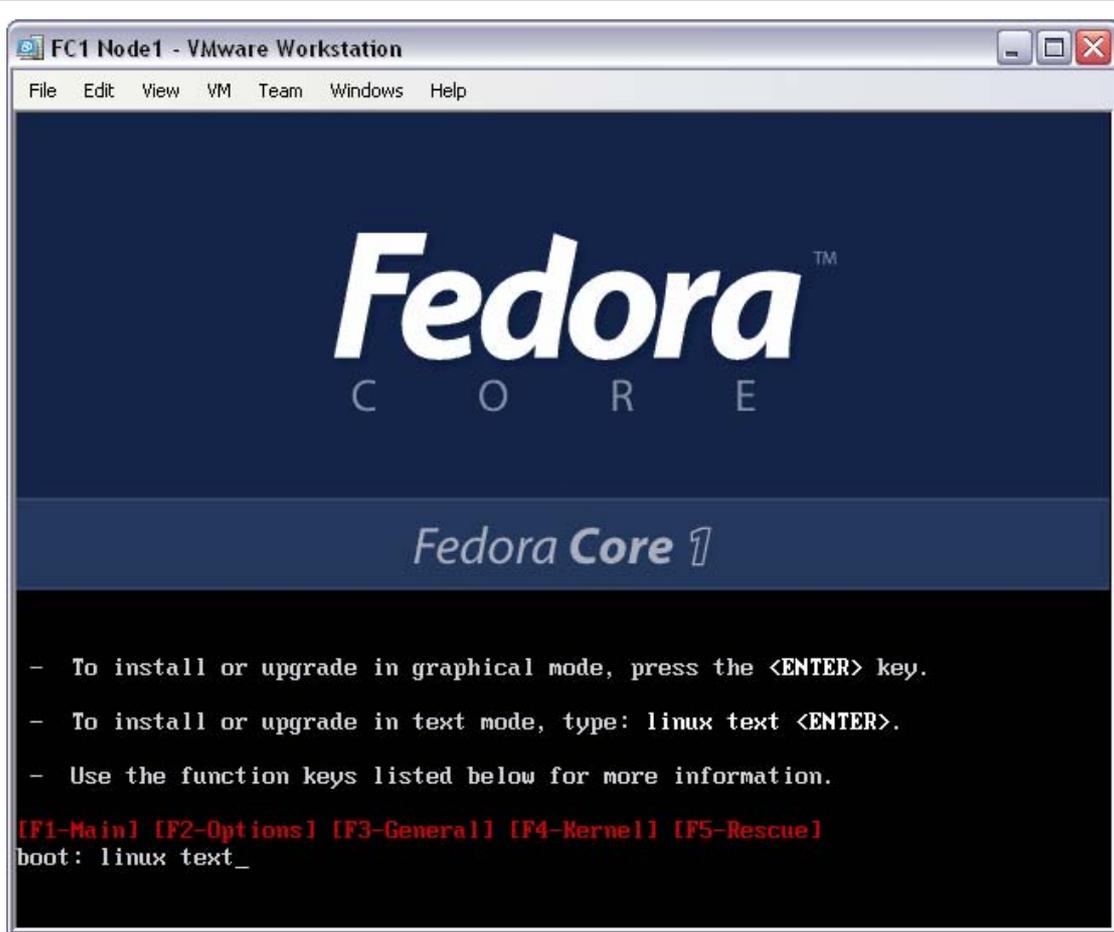
Allow the installer to start the installation program. It will begin with the media checking program.
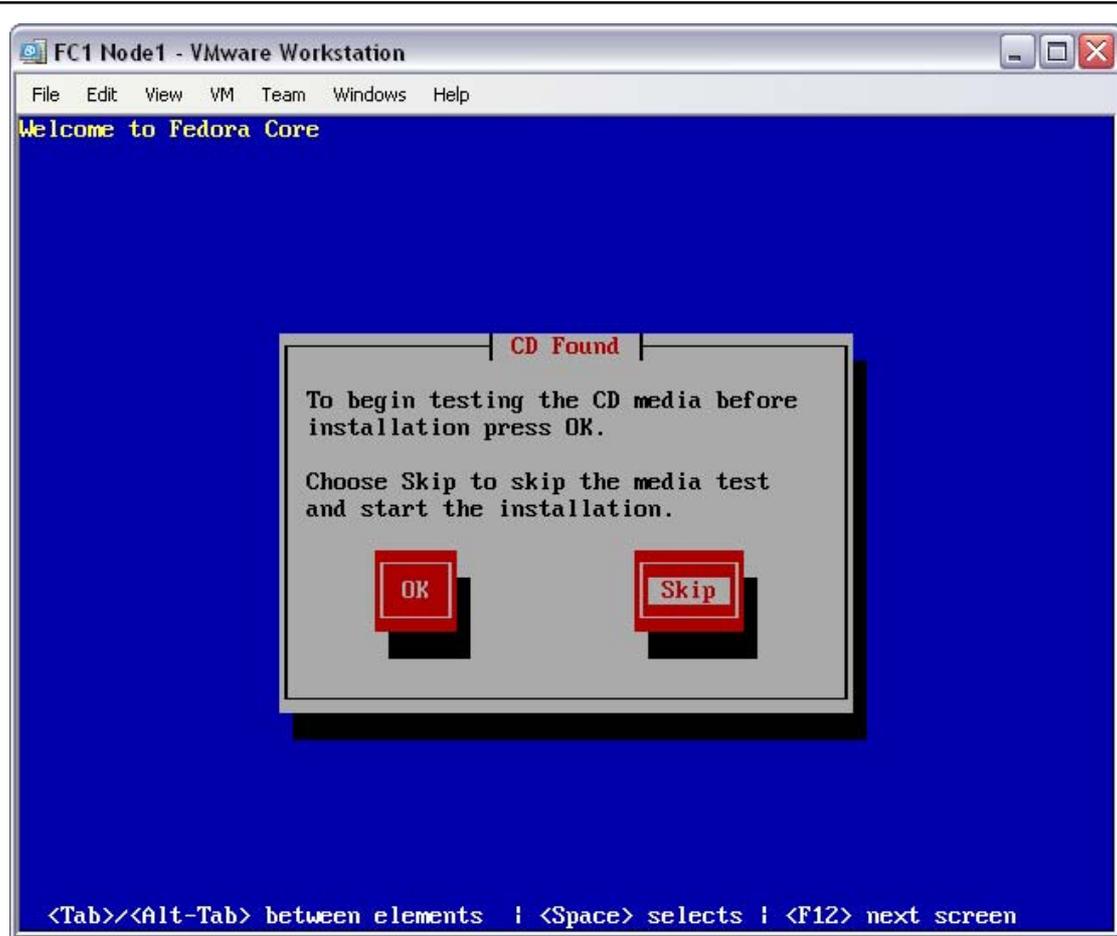
There is no need to check the CD media, select "Skip".

Action	Skip the CD media check, select "Skip" and press enter

The Yarrow installation program will now begin to take installation configuration options.

4.2 Configure the hardware environment

Welcome to the real start of Yarrow installation process. The installer will display the "Welcome to Fedora Core" screen.
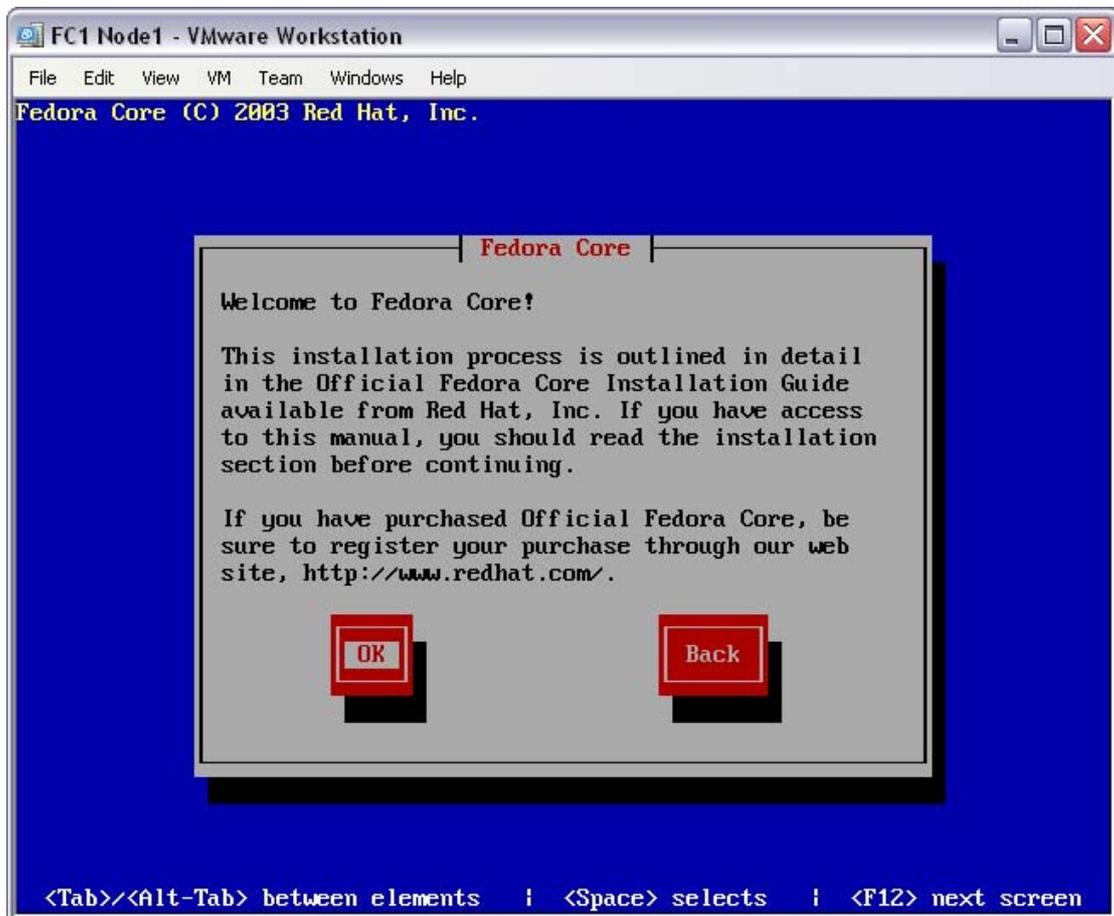
At the "Welcome to Fedora Core" screen, select "Ok".

Action	At the Welcome screen, select "Ok" and press enter

The installer will move on to language selection.
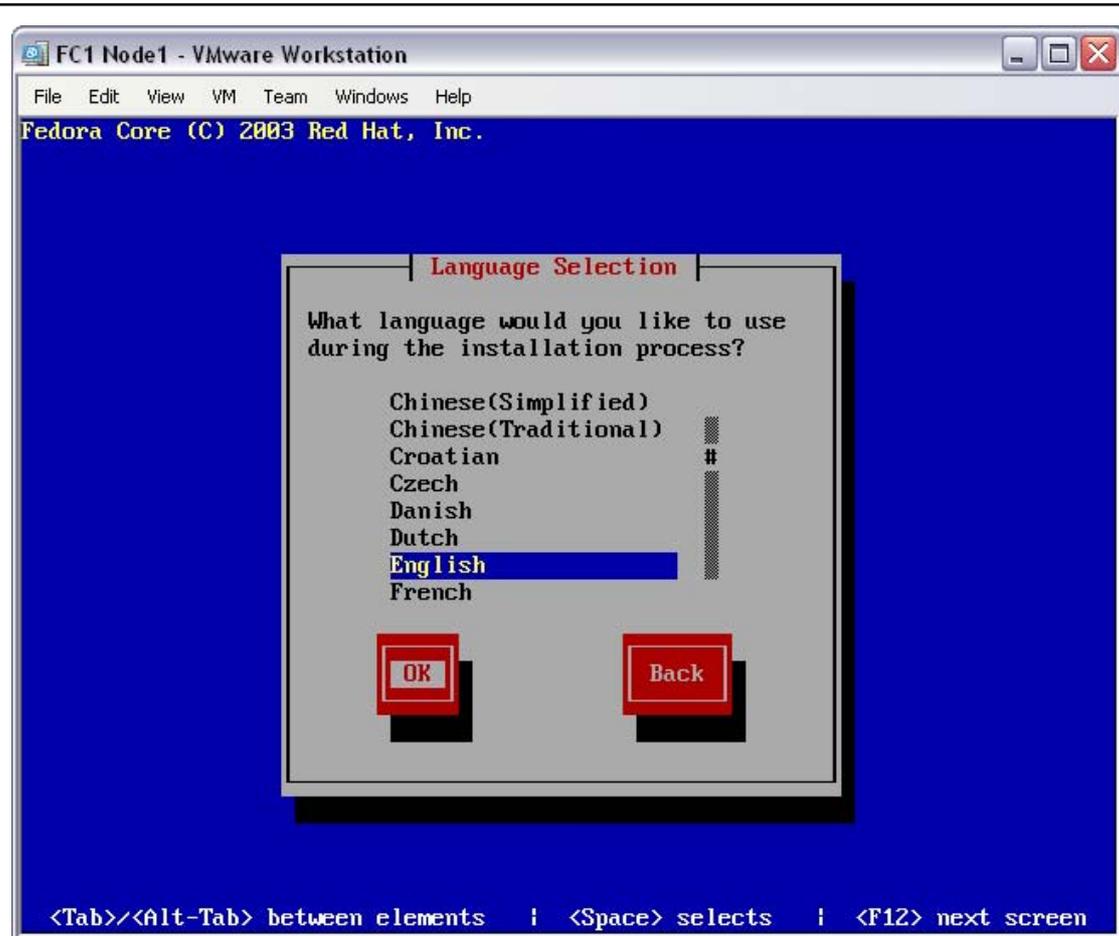
As this document has been written in English, this will be used as the language default. At the "Language Selection" screen, select "English", then "Ok".

Action	At the Language Selection screen, select "English", then select "Ok" and press enter

The installer will move on to keyboard selection.
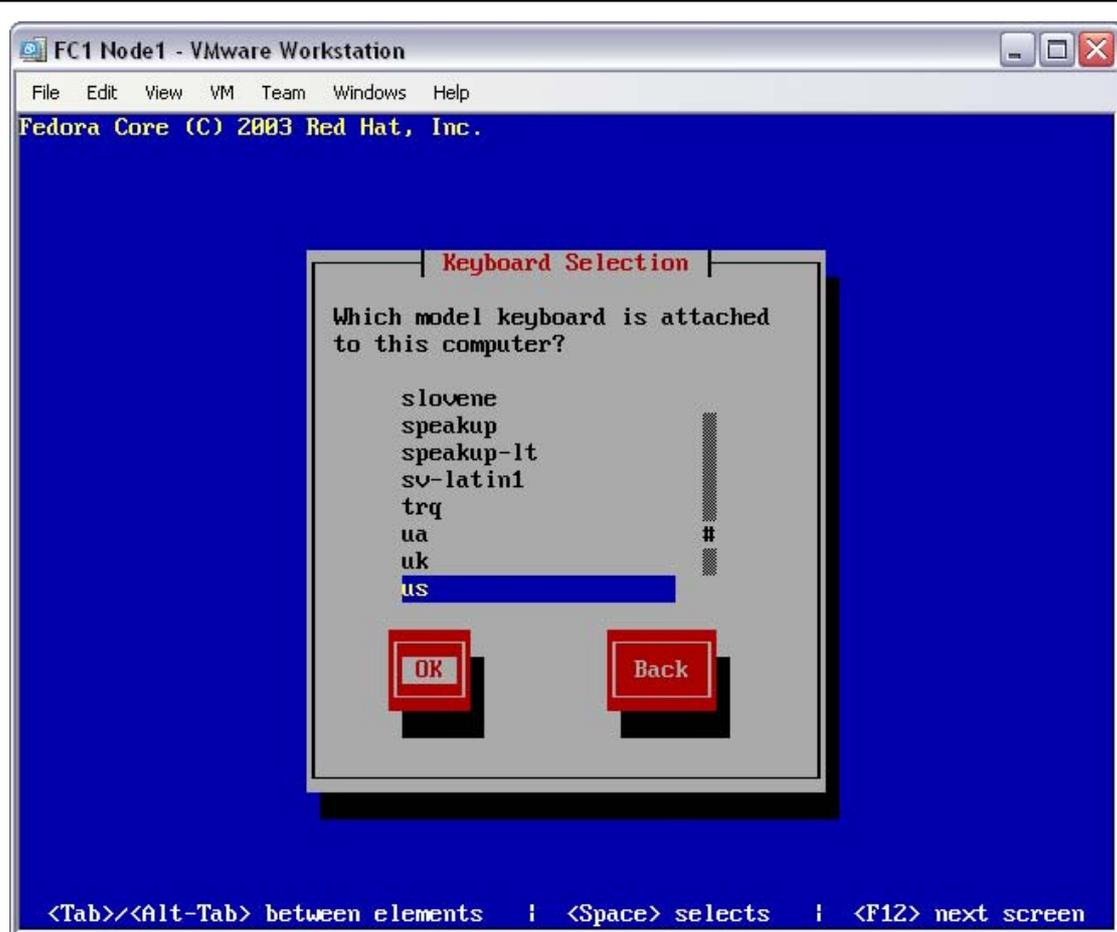
As this document has been written in Australia, local keyboard type (US) will be used as the default. At the "Keyboard Selection" screen, select "us", then "Ok".

Action	At the Keyboard Selection screen, select "us", then select "Ok" and press enter

The installer will move on to mouse selection.
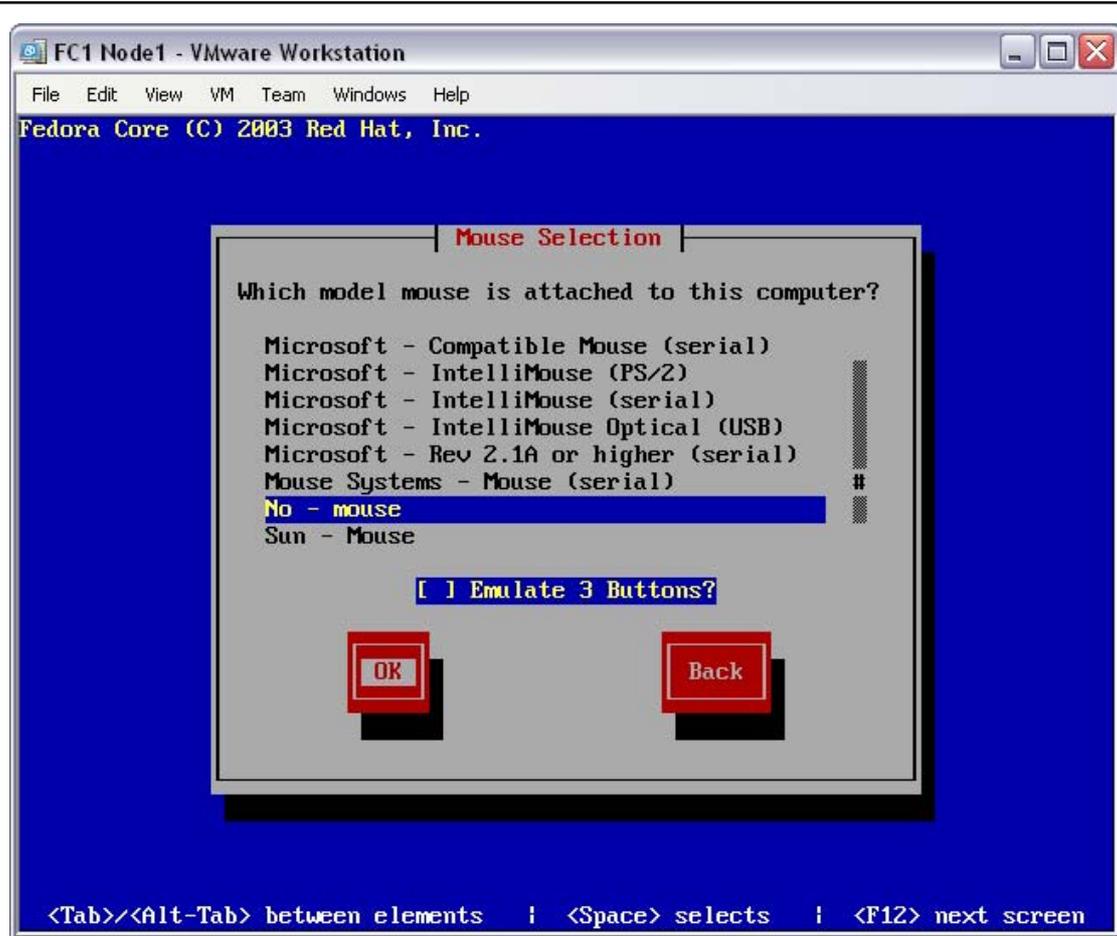
This system will not be configured with an X11 (X-Windows) interface – there will be no Graphical User Interface. No mouse will be required.

At the "Mouse Selection" screen, select "No - mouse", then "Ok".

Action	At the Mouse Selection screen, select "No - mouse", then select "Ok" and press enter

The installer will move on to monitor selection.

```
FC1 Node1 - VMware Workstation                                    _ □ ✕

 File  Edit  View  VM  Team  Windows  Help

Fedora Core (C) 2003 Red Hat, Inc.




              ┤ Monitor Configuration ├

      Select the monitor for your system.  Use the 'Default'
      button to reset to the probed values.

      Monitor:         Unprobed Monitor         <Change>

      HSync Rate:      31.5-37.9                 <Change>
      VSync Rate:      50-70

            OK            Default            Back




 <Tab>/<Alt-Tab> between elements  ¦  <Space> selects  ¦  <F12> next screen
```
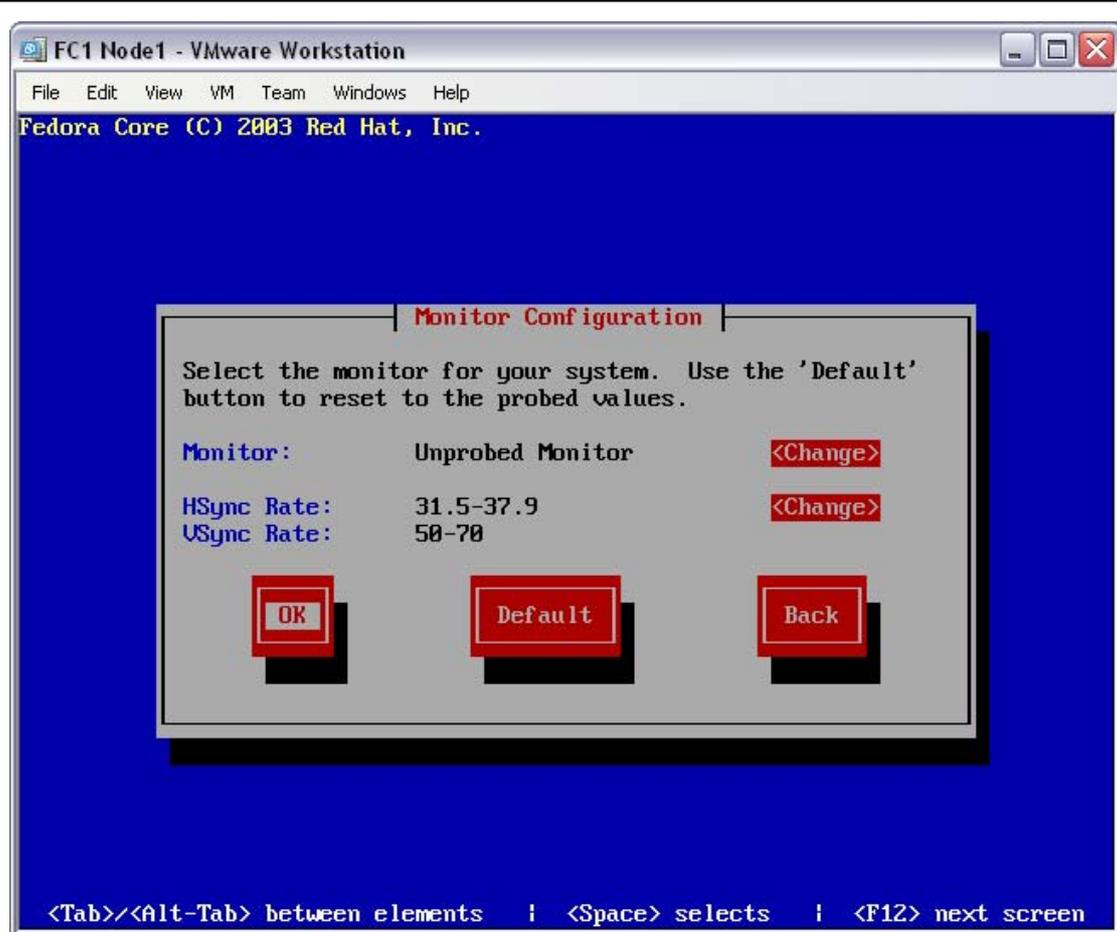
As this system will not be configured with an X11 interface, there won't be a requirement for any graphical display modes. The monitor won't leave its default 80x25 terminal mode.

At the "Monitor Configuration" screen, select "Ok" (even for "Unprobed Monitor" types).

Action	At the Monitor Configuration screen, select "Ok" and press enter

The installer will move on to the monitor validation screen.
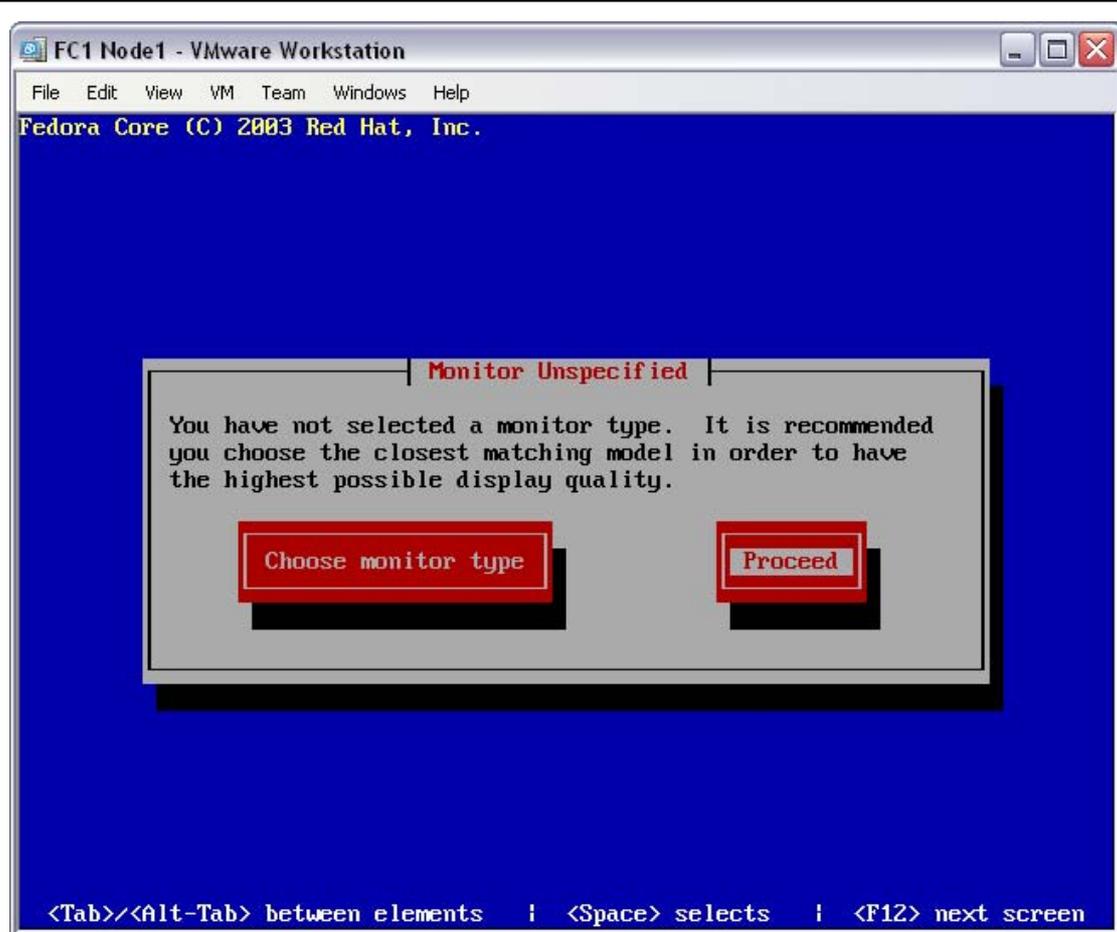
If the monitor on the PC being built is not recognised, you may be prompted to accept the default configuration settings. These settings should be fine for any monitor not switching to high resolution graphical modes.

If it appears, at the "Monitor Unspecified" screen, select "Proceed".

Action	At the Monitor Unspecified screen, select "Proceed" and press enter

With the hardware environment configured, the Yarrow installation program will now begin to tune the type of installation, and partition the disks accordingly.

4.3   Configure the installation type and disk configuration

Now that he hardware environment has been configured, the installation process will identify the build type, and then partition the local disks. The "Installation Type" screen will be displayed.
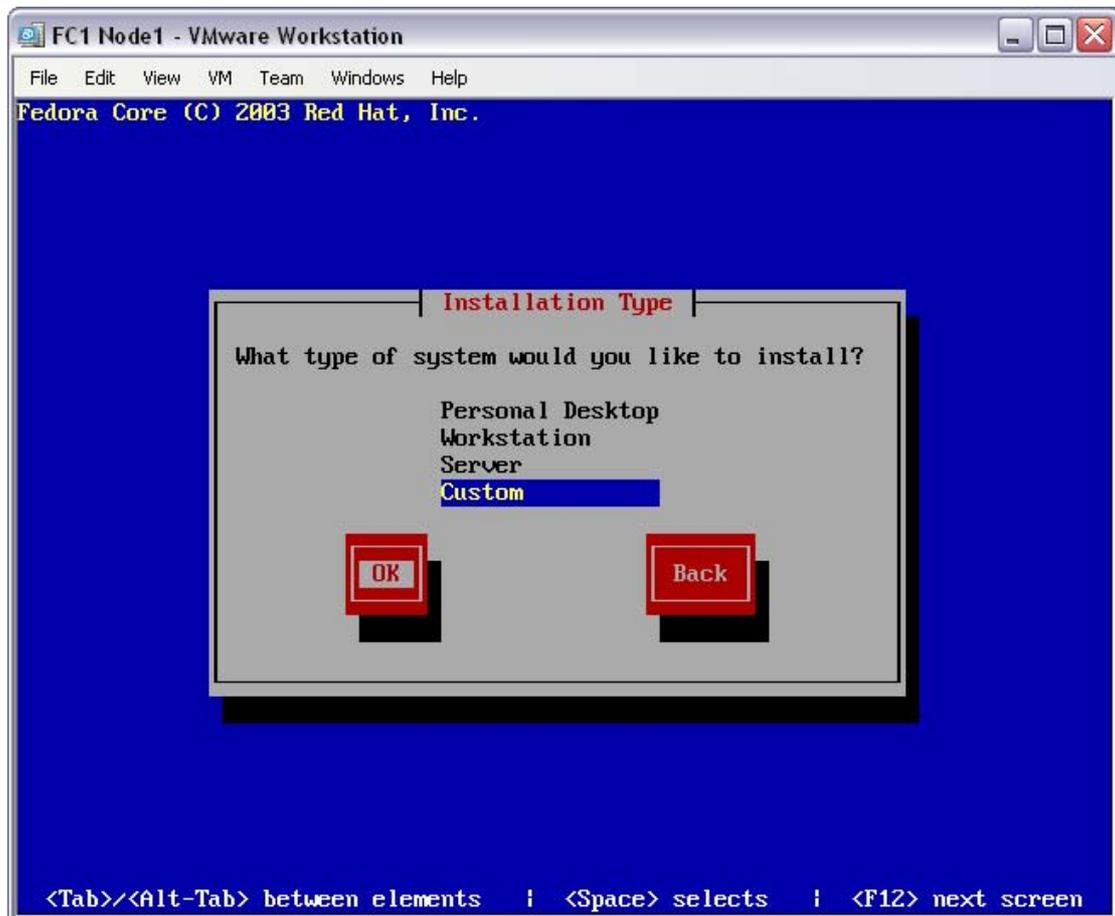
As a demonstration, there is no need for a complex or massive installation in order to support openMosix. The build type selected here will be used to minimise the total quantity of software installed.

At the "Installation Type" screen, select "Custom" and then "Ok".

Action	At the Installation Type screen, select "Custom", then select "Ok" and press enter

The installer will move on to the disk partitioning setup screen.
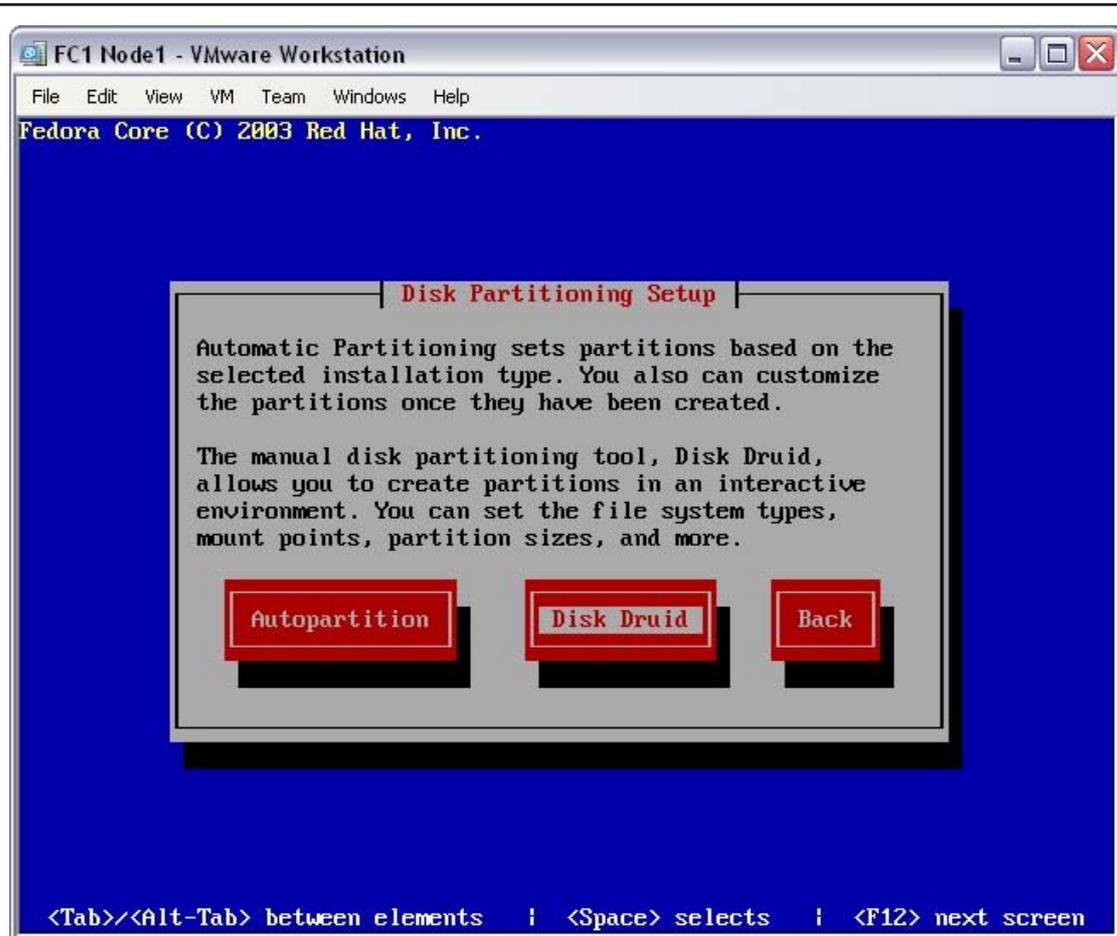
During testing it was found that the "Autopartition" option would not always work. For reliability, the "Disk Druid" (manual) option has been documented.

At the "Disk Partitioning Setup" screen, select "Disk Druid".

Action	At the Disk Partitioning Setup screen, select "Disk Druid", and press enter

The installer will move on to the disk partitioning warning screen.
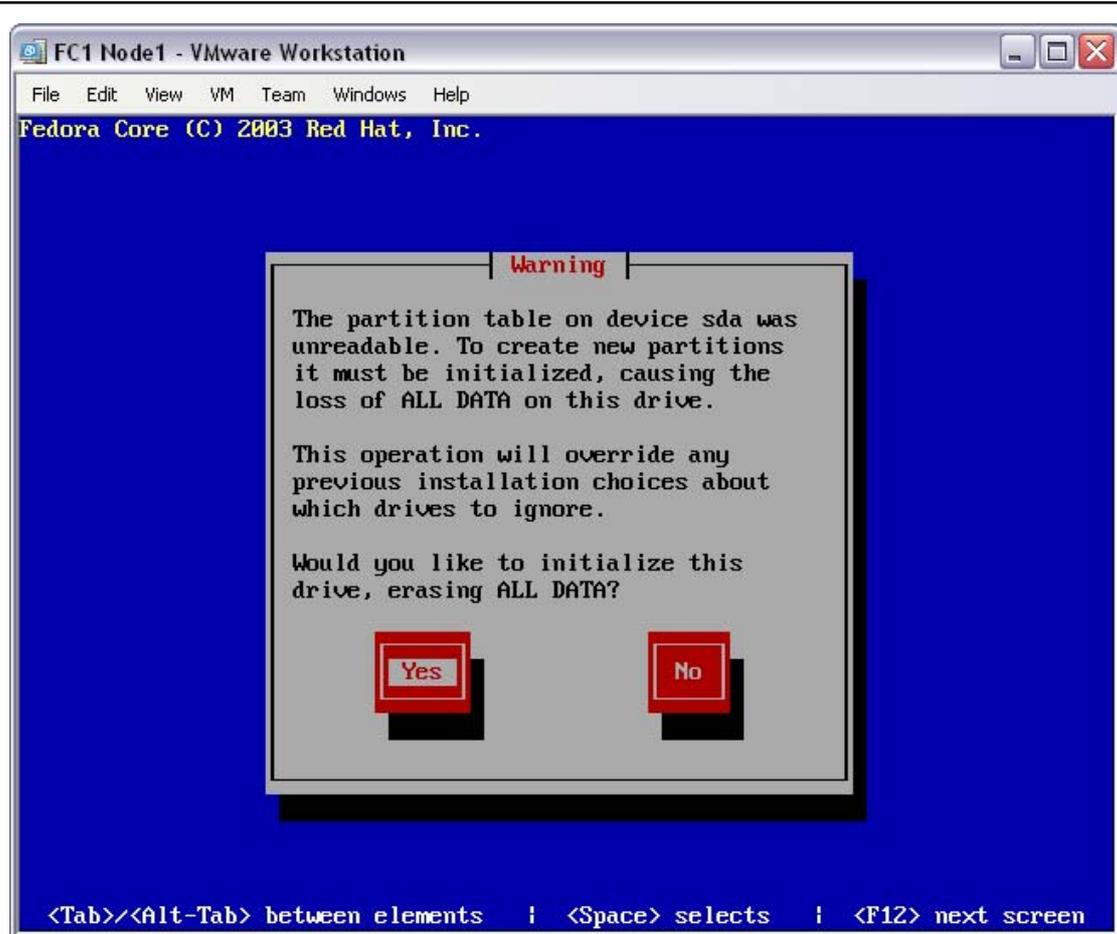
All data on your computer's hard disk will be destroyed. Accepting this warning message will lead to the unrecoverable deletion of all of your data!

At the disk partitioning "Warning" screen, select "Yes".

Action	At the disk partitioning Warning screen, select "Yes", and press enter

The installer will move on to the disk partitioning configuration screen.

NB: If you are not using a blank hard disk (i.e. this hard disk has had a previous Operating System installed) then you will need to delete any existing partitions.
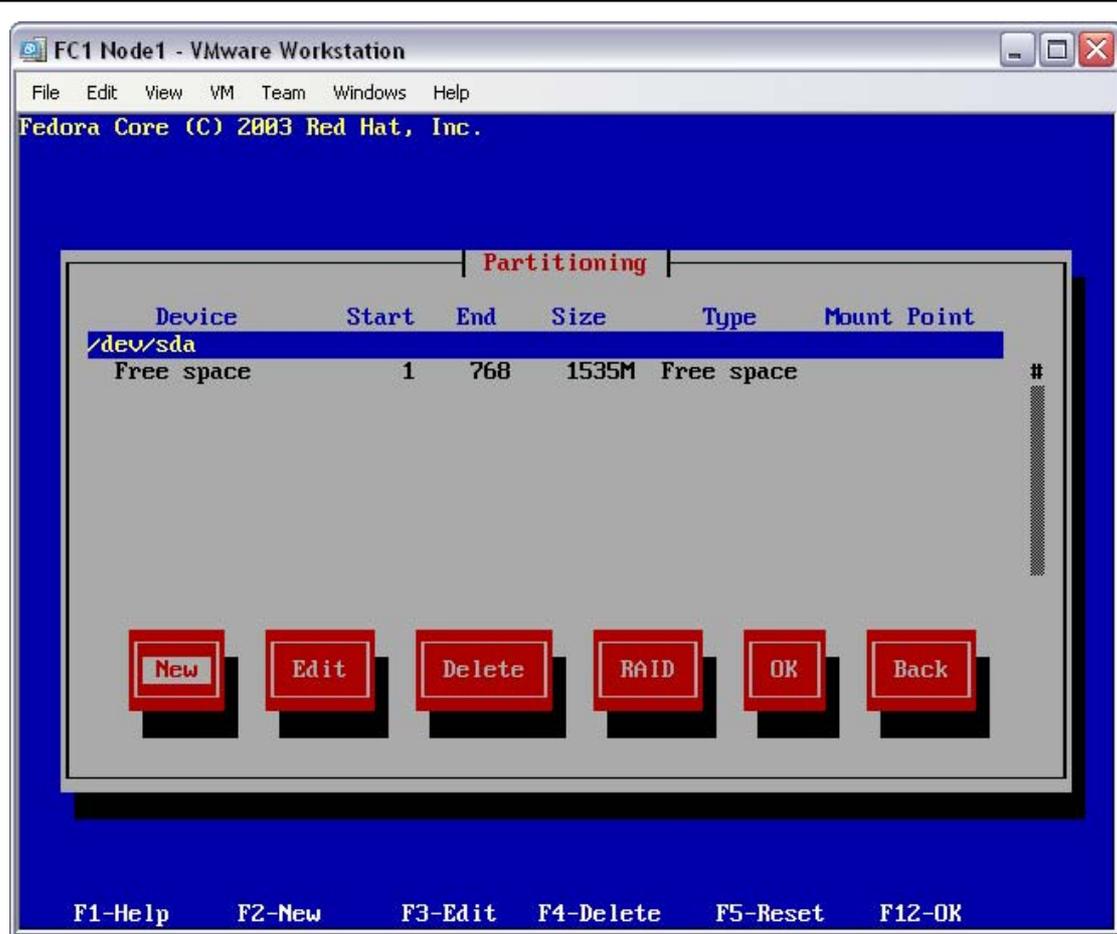
Starting with a blank disk (see note above if old partitions exist)

At the disk "Partitioning" screen, select "New".

Action	At the disk Partitioning screen, select "New", and press enter

The installer will move on to the add partition screen.
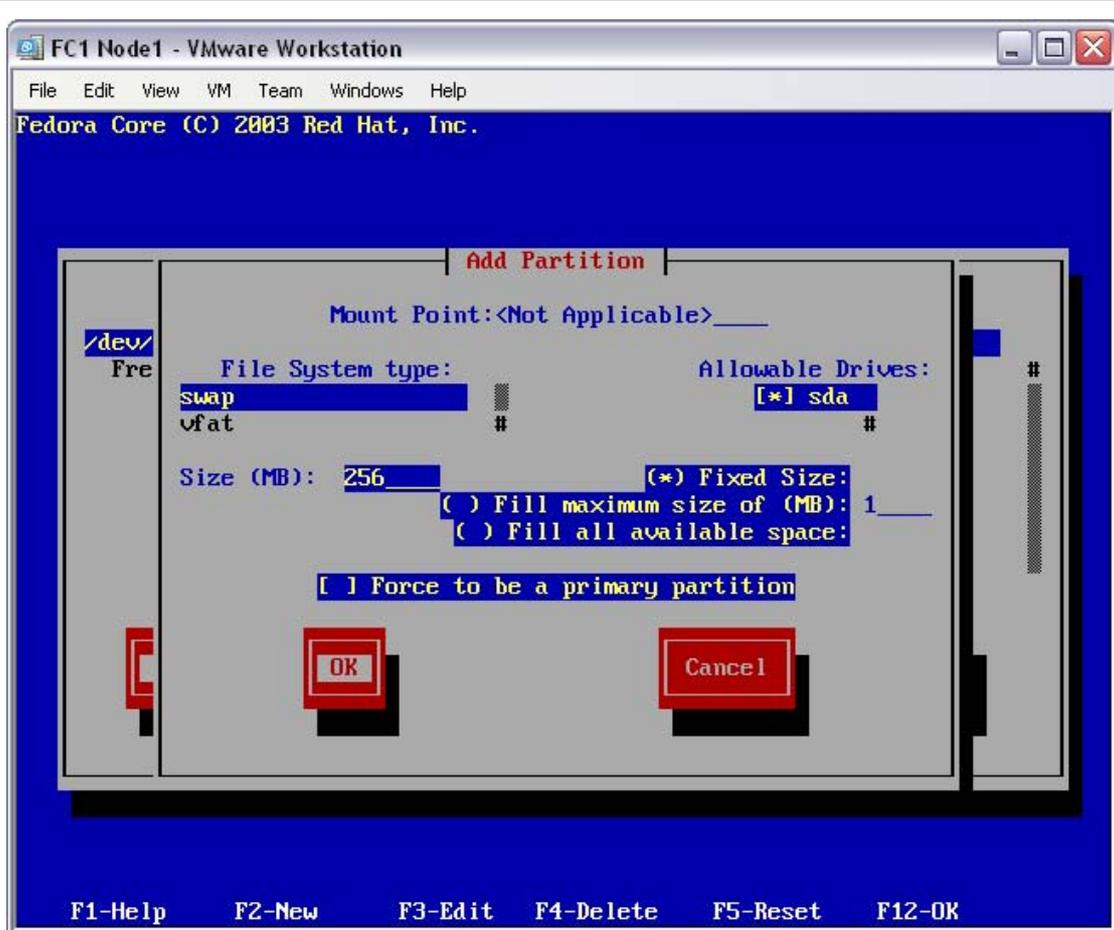
The first file system is swap – this is the computer's swap-space for use in cases of high memory demand.

Select the file system type of "swap", enter the size in Mbytes of "256", then select "Ok".

Action	At the Add Partition screen, select the File System Type of "swap", enter the Size of "256", select "Ok" and press enter

The installer will move on to the disk partitioning configuration screen.
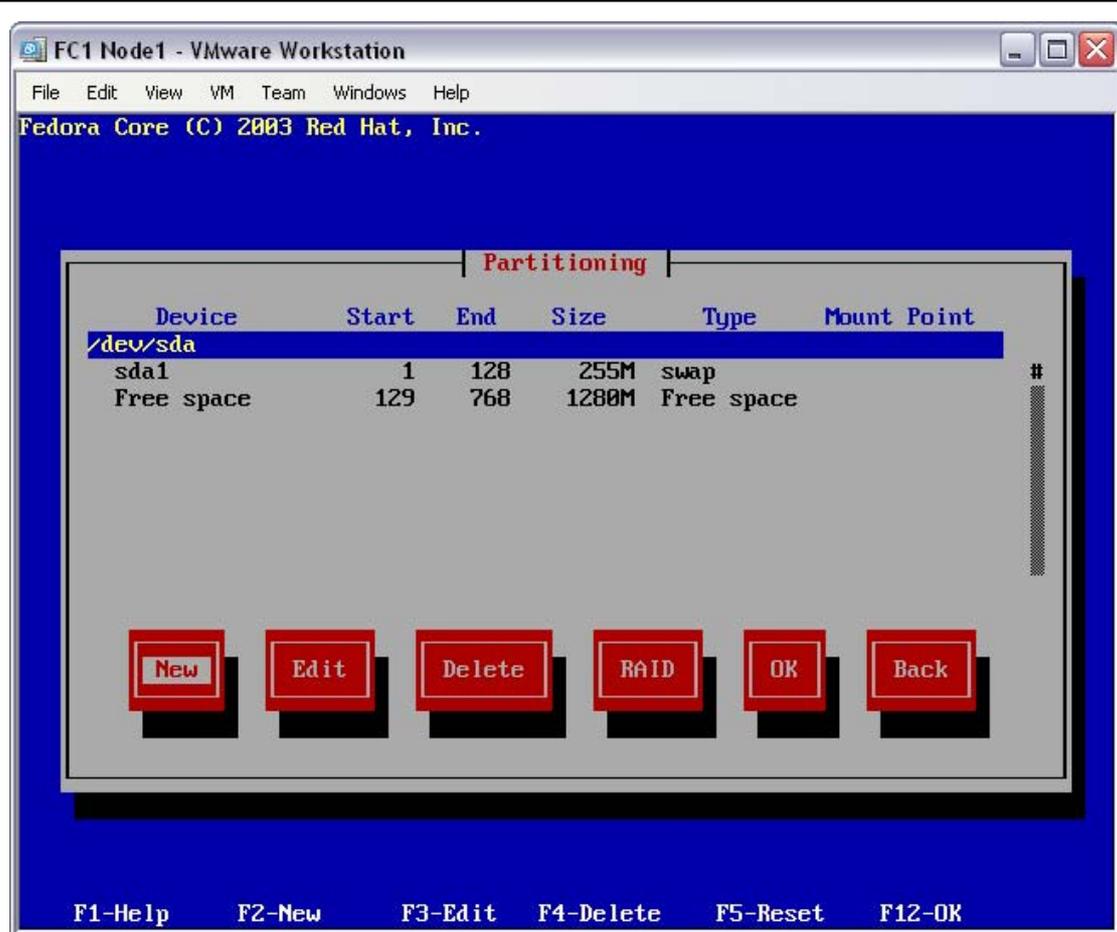
You should now have one partition, of type "swap", in the partition table. The rest of the disk should be labelled as "Free space". Now, create the system partition.

At the disk "Partitioning" screen, select "New".

Action	At the disk Partitioning screen, select "New", and press enter

The installer will move on to the add partition screen.
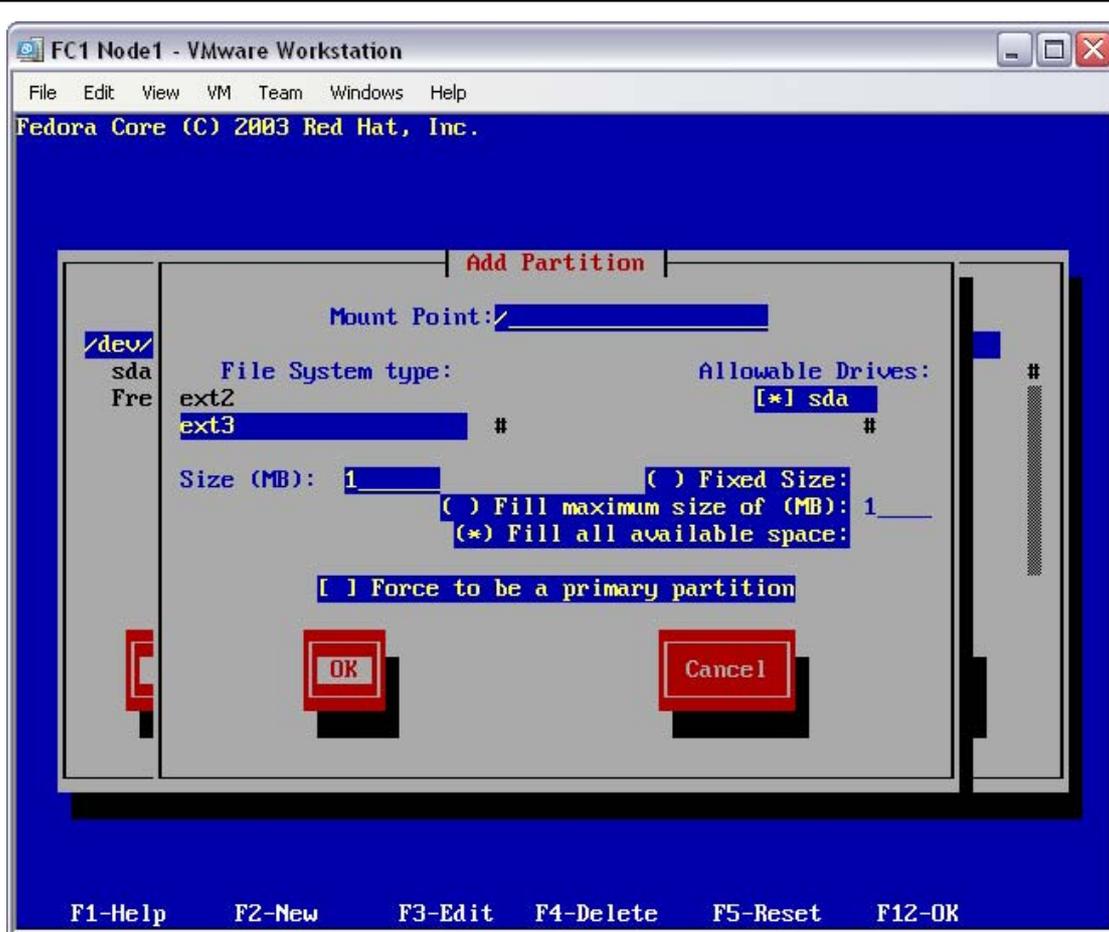
The second file system is the system partition – this is going to be the partition used for the computer's root file system, and will house all of the software stored on this computer. It will fill all of the remaining space of the disk – this must be at least 1.2Gbytes.

Enter a Mount Point of "/", select the file system type of "ext3", select the "Fill all available space" option, then select "Ok".

Action	At the Add Partition screen, enter a Mount Point of "/", select the File System Type of "ext3", select the "Fill all available space" option, select "Ok" and press enter

The installer will move on to the disk partitioning configuration screen.
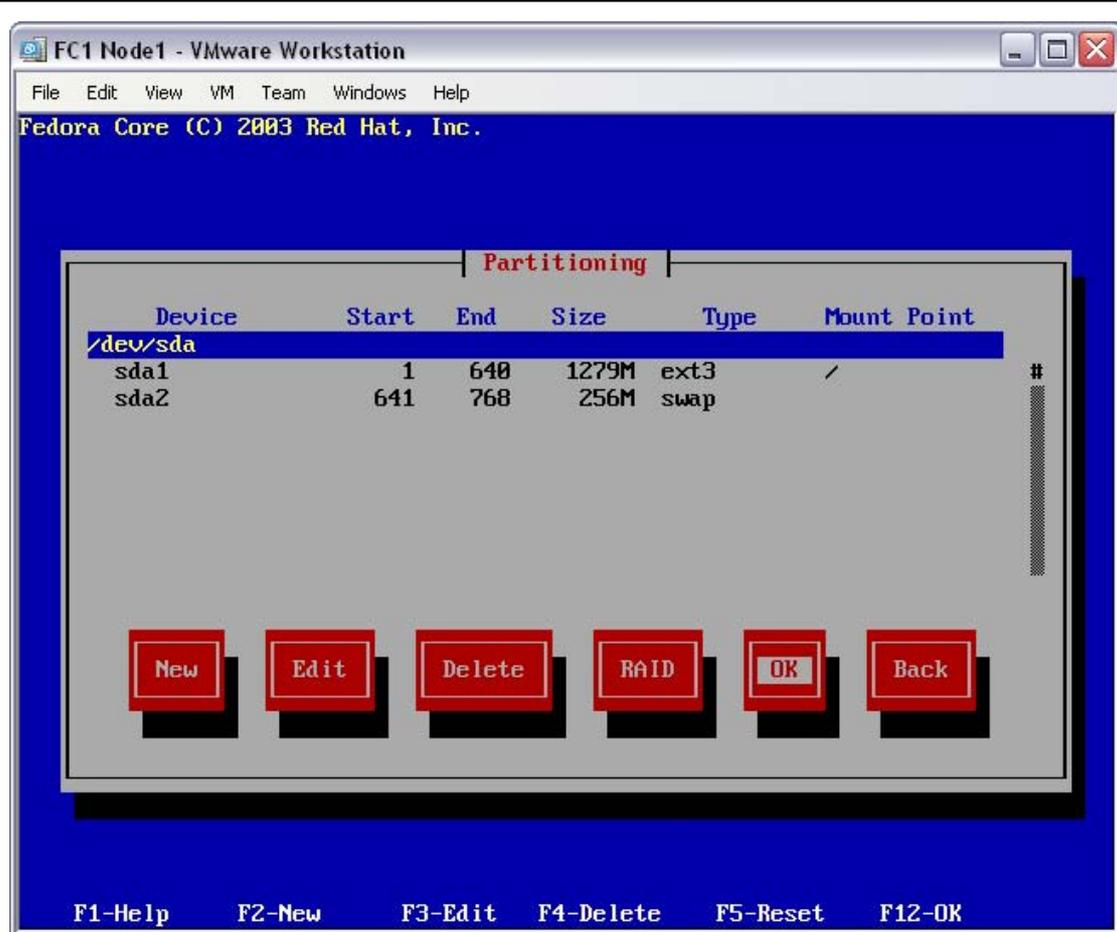
You should now have two partitions; sda1 of at least 1.2Gbytes at mount point "/", and sda2 of about 256Mbytes of type "swap", in the partition table. There shouldn't be and free space left on the disk.

At the disk "Partitioning" screen, select "Ok".

Action	At the disk Partitioning screen, select "Ok", and press enter

The installer will move on to the boot loader configuration screen.
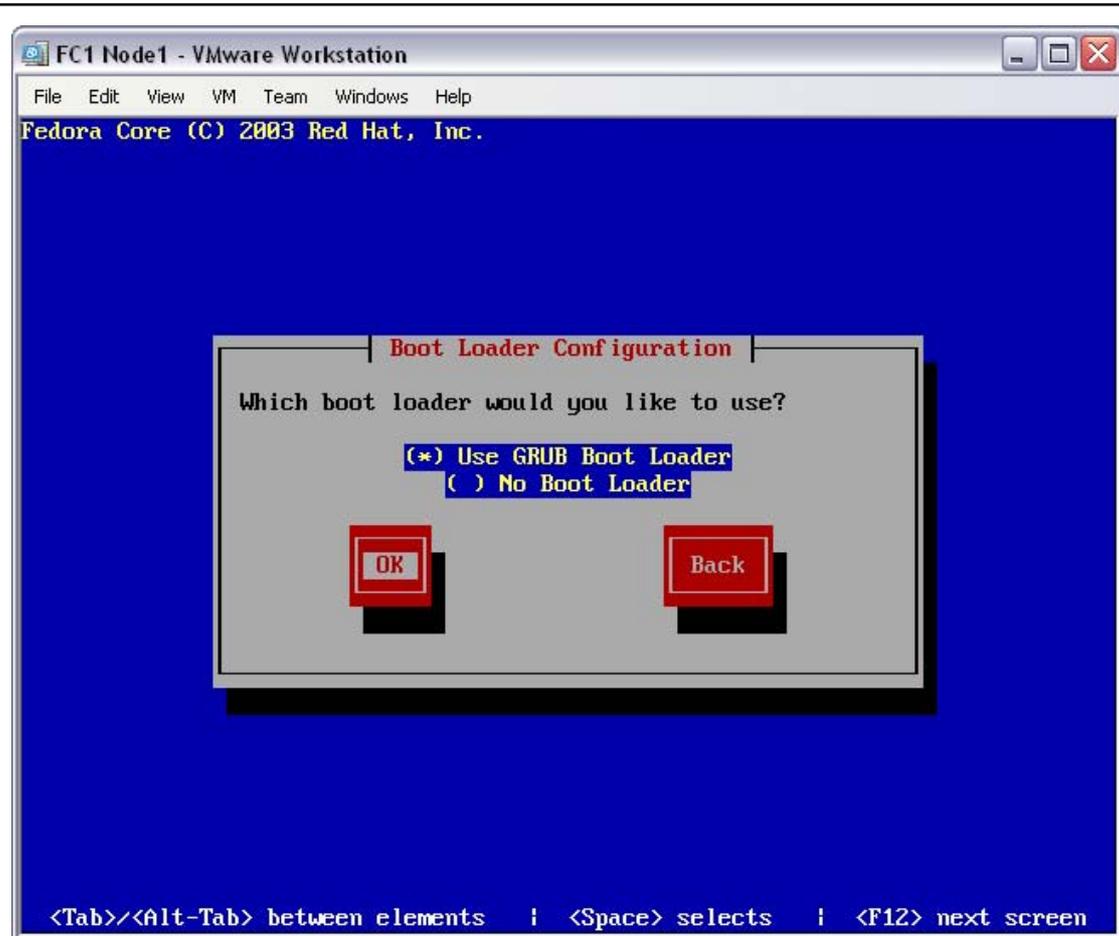
The default boot loader is Grub. It is a suitable boot loader for this computer.

At the disk "Boot Loader Configuration" screen, select "Ok".

Action	At the disk Boot Loader Configuration screen, select "Ok", and press enter

The installer will move on to the boot loader configuration options screen.
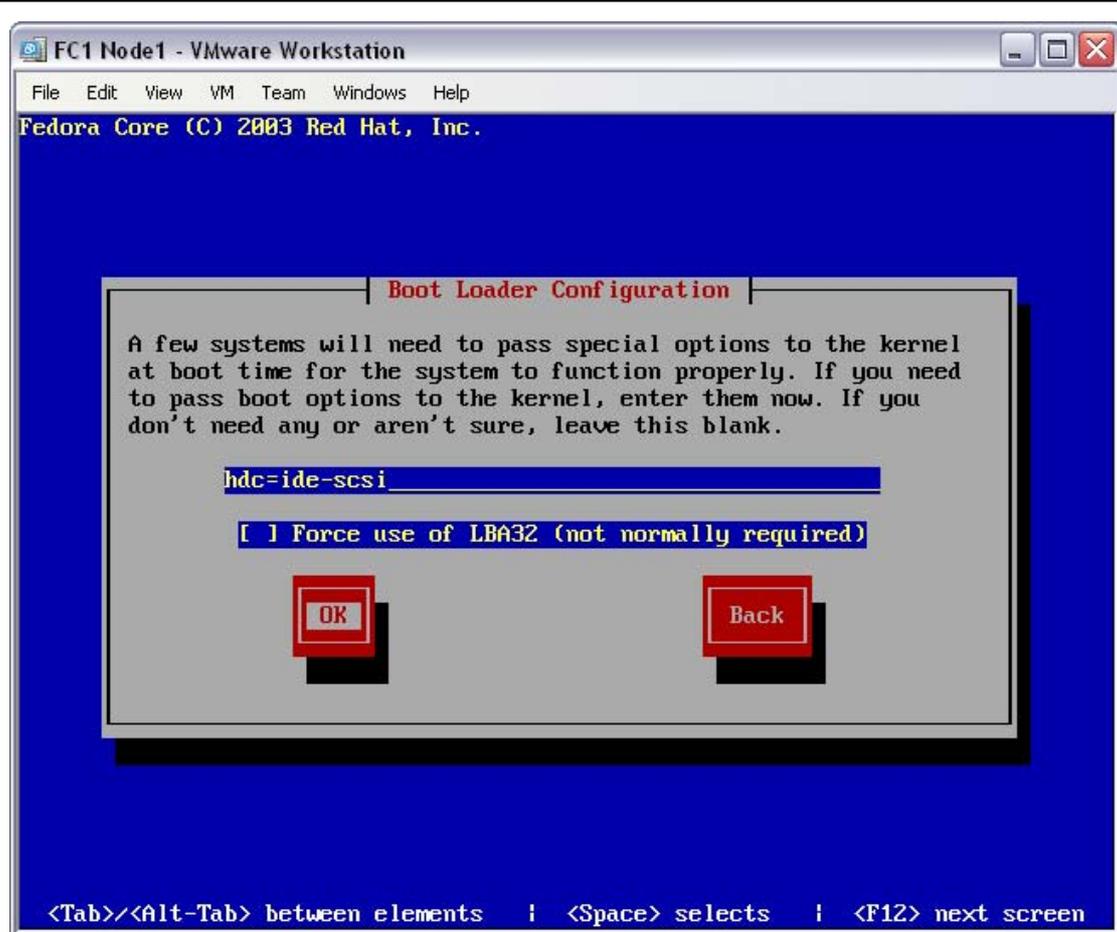
The default boot loader options are fine. In the test case (shown) the VMWare CDROM drive was automatically configured with the option "hdc=ide-scsi" – there is no need to add or remove any options to this dialogue.

At the disk "Boot Loader Configuration" options screen, select "Ok".

Action	At the disk Boot Loader Configuration options screen, select "Ok", and press enter

The installer will move on to the boot loader configuration password screen.
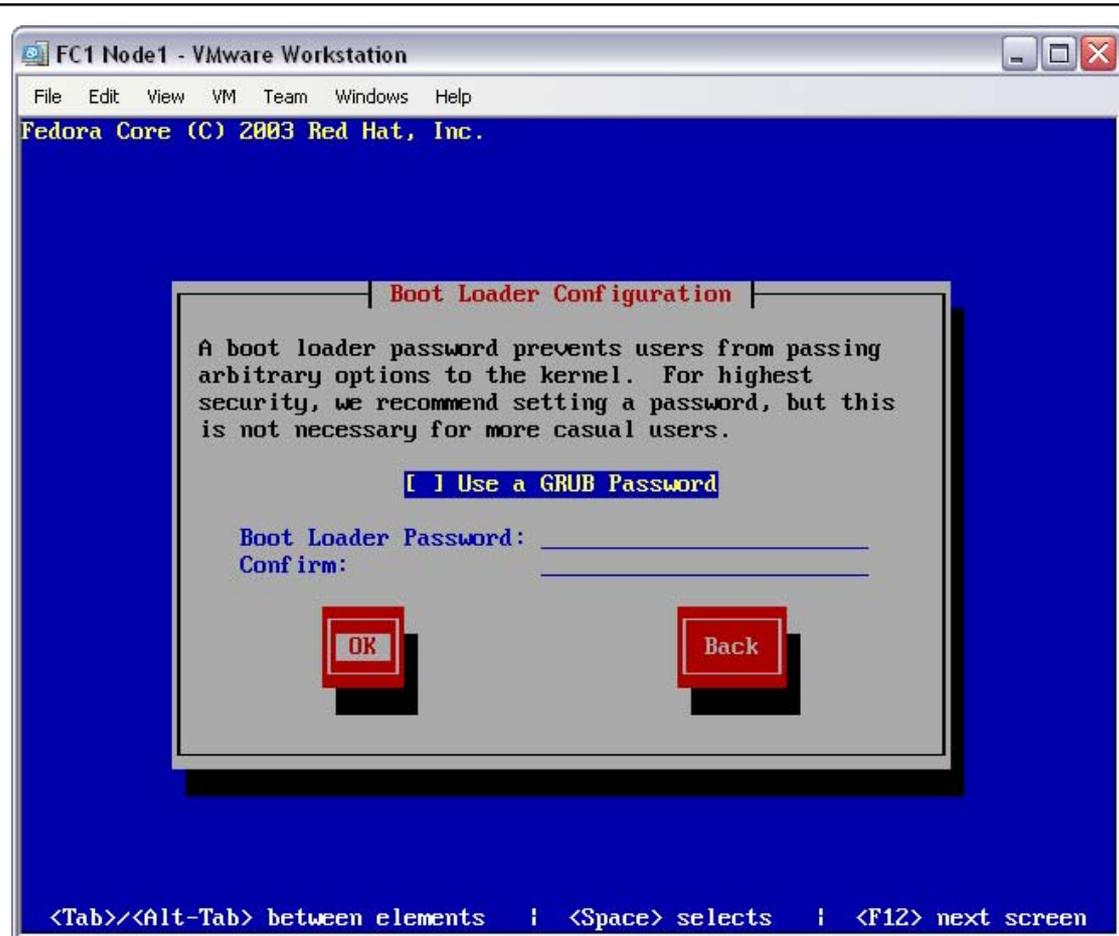
There is no need for a Grub password, do not set this option.

At the disk "Boot Loader Configuration" password screen, select "Ok".

Action	At the disk Boot Loader Configuration password screen, select "Ok", and press enter

The installer will move on to the boot loader configuration OS screen.
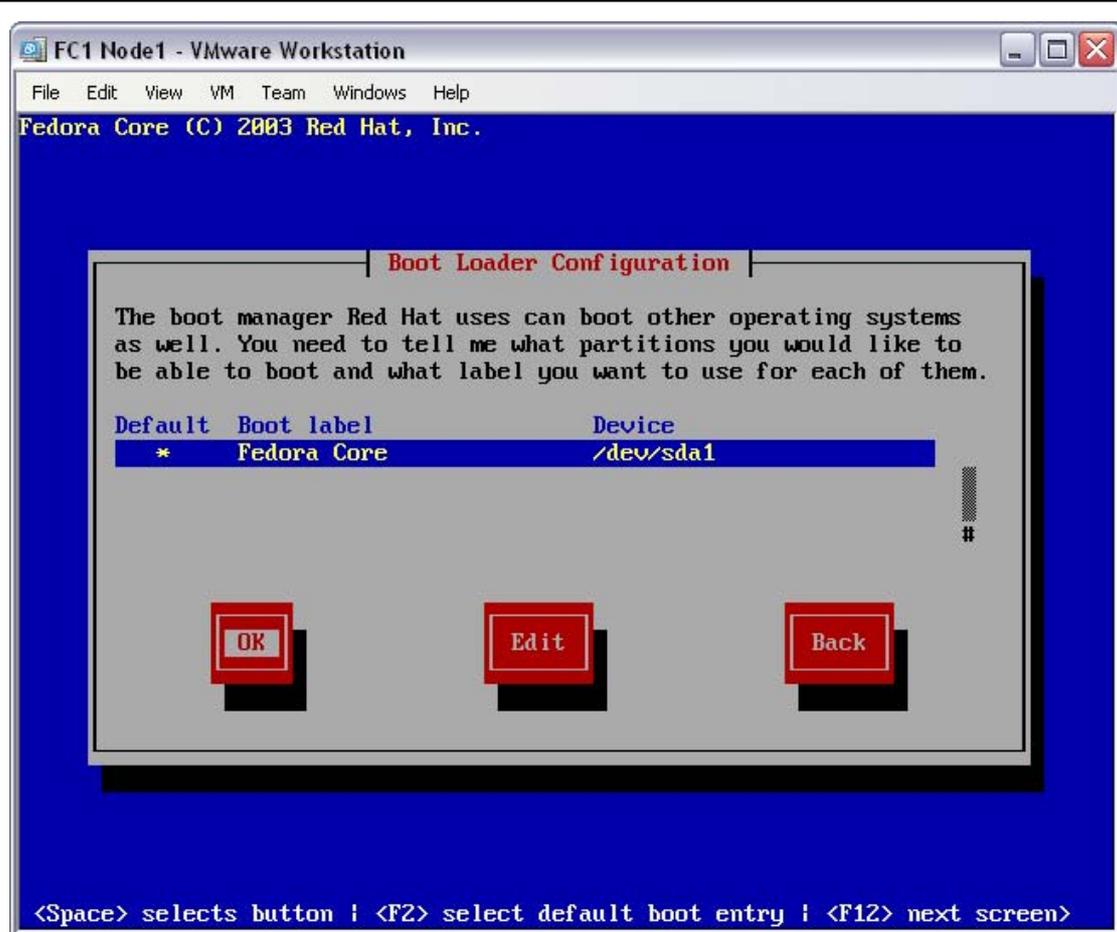
As this is not a multi-boot machine (this computer has only the Fedora Core 1 OS installed on it) default partition is fine.

NB: Observe the device used for the Boot Loader Configuration (/dev/sda1 in this case). The disk device (/dev/sda in this case) will be used during the openMosix installation, later in the build process.

At the disk "Boot Loader Configuration" OS screen, select "Ok".

Action	At the disk Boot Loader Configuration OS screen, select "Ok", and press enter

The installer will move on to the boot loader configuration installation screen.
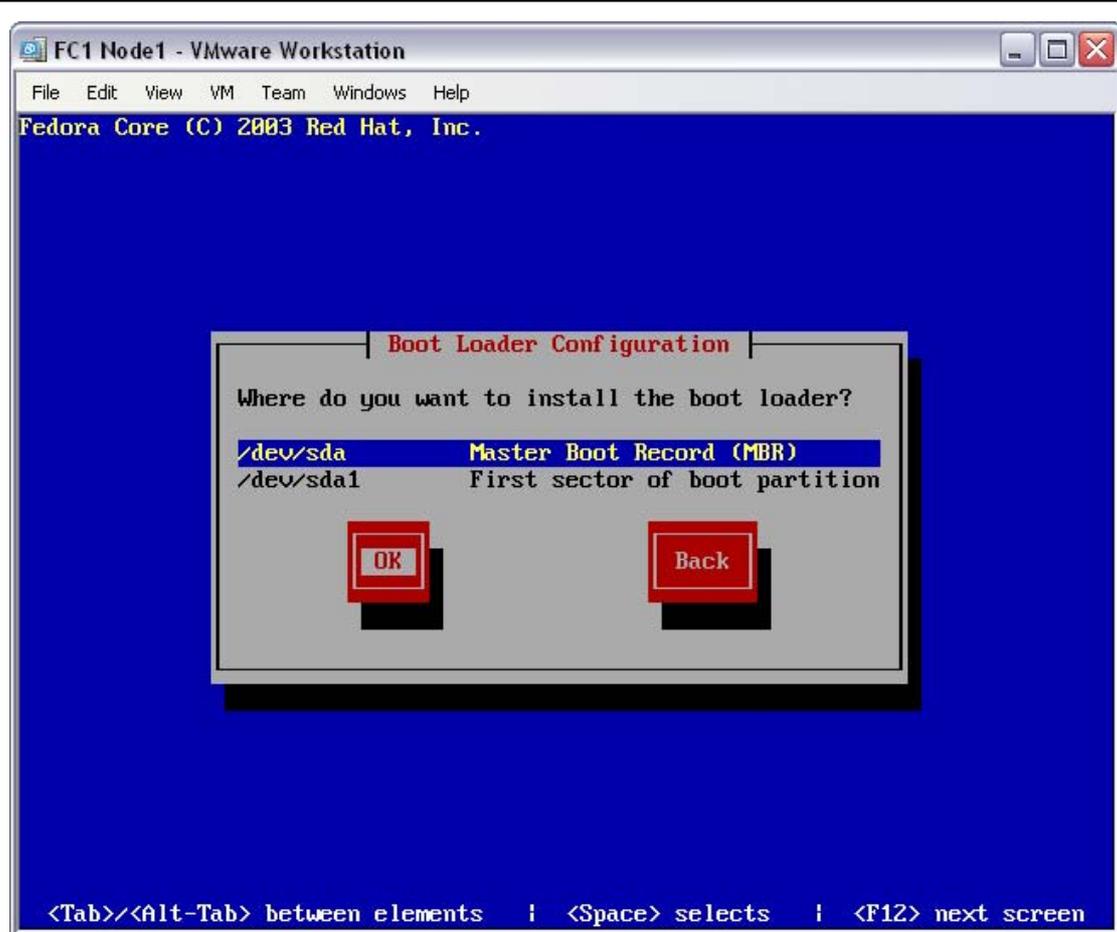
The default disk or partition is fine for the Grub installation.

At the disk "Boot Loader Configuration" installation screen, select "Ok".

Action	At the disk Boot Loader Configuration installation screen, select "Ok", and press enter

With the installation type and disk configuration established, the Yarrow installation program will now begin to configure the networking environment for this computer.

4.4   Configure the network environment

With the build type selected and local disk partitions configured, the installation process will ask for the network configuration (including the firewall). The "Network Configuration for eth0" screen will be displayed.
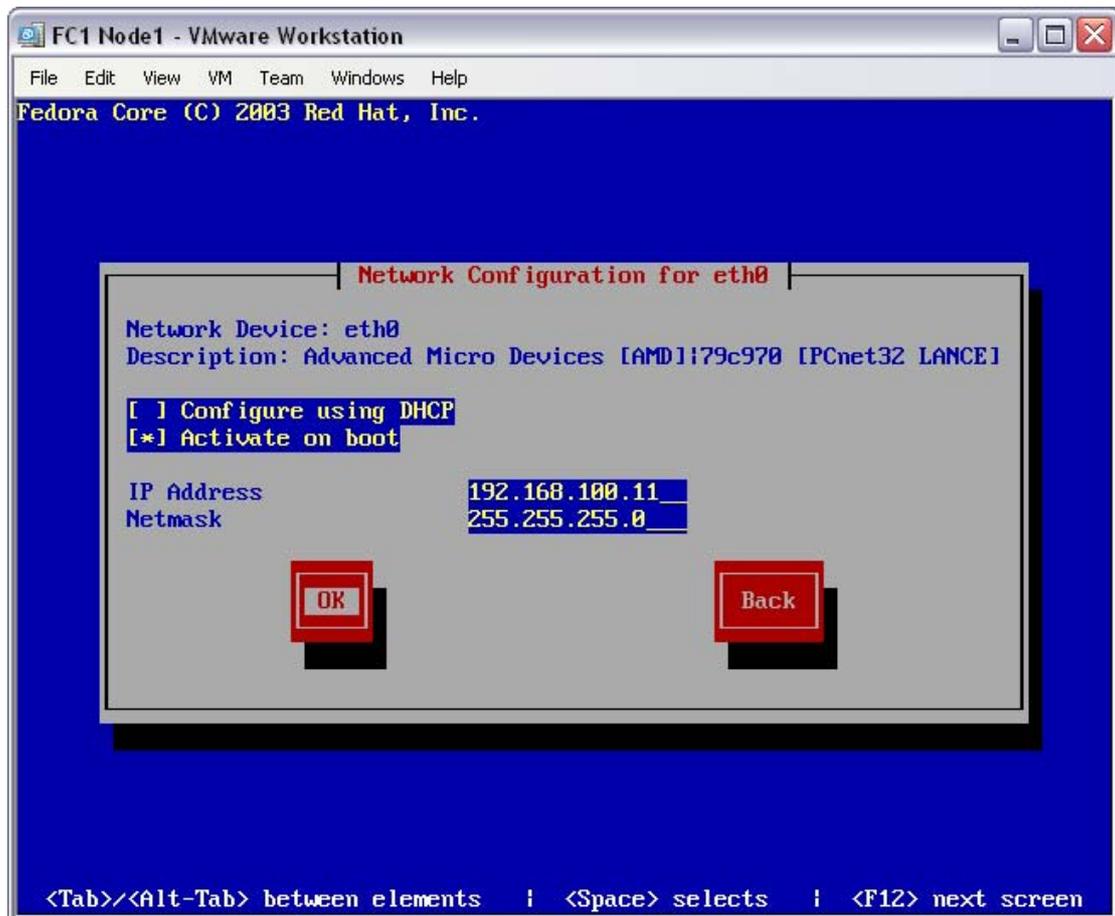
For simplicity's sake, this build assumes that you don't have a DHCP server on your network (LAN). This, then, allows you to use two PCs with a cross-over cable as the local LAN segment. The IP addressing selected here is arbitrary, but all PCs must be in the same subnet (i.e. all in 192.168.100.x/255.255.255.0).   PC's will be assumed to be in the range of 192.168.100.11-192.168.100.254.

At the "Network Configuration for eth0" screen, de-select "Configure using DHCP", enter the "IP Address", enter the "Netmask" and then select "Ok".

Action	At the Network Configuration for eth0 screen, de-select "Configure using DHCP", enter the "IP Address", enter the "Netmask", then select "Ok" and press enter

The installer will move on to the miscellaneous network settings screen.
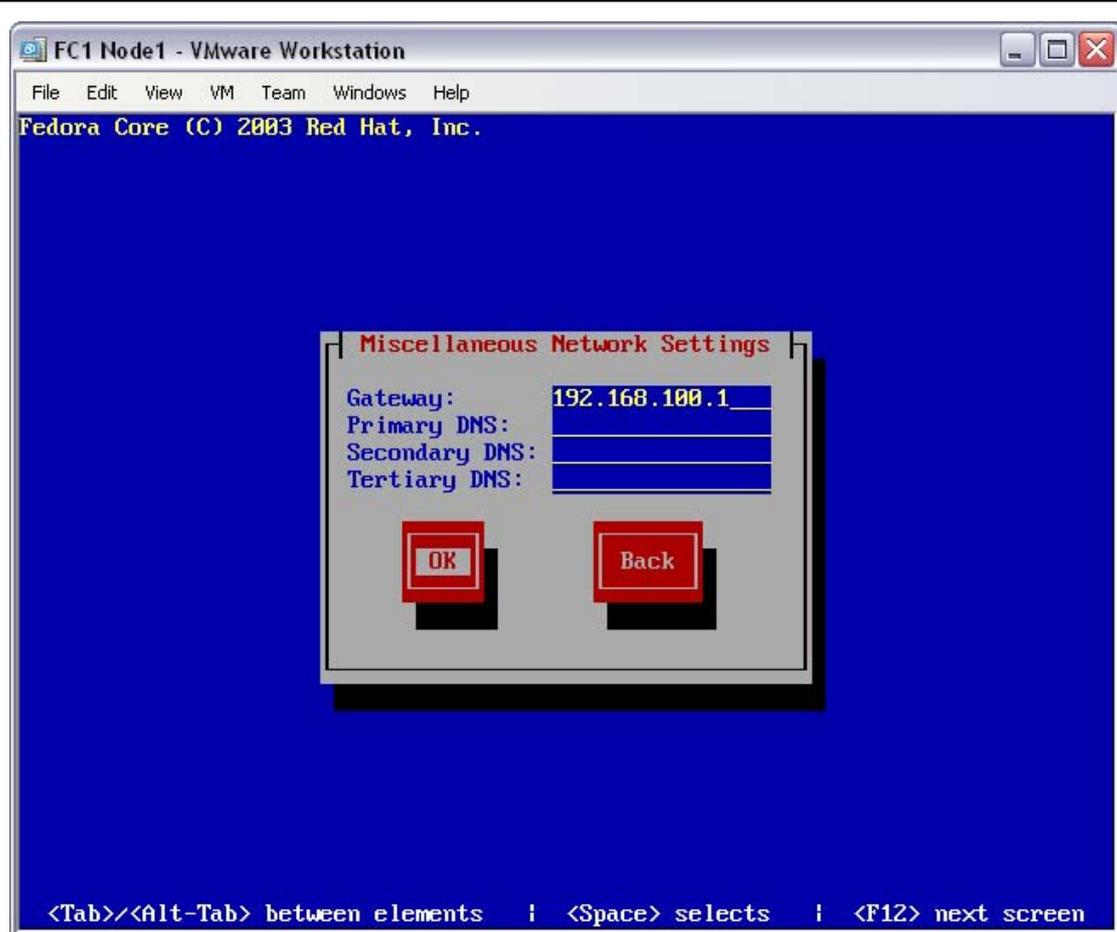
The default gateway for this LAN segment does not need to be an actual device on the LAN (as noted in the cross-over example) but does need to be configured. Also, as you may be using a cross-over cable, and as there is no need for it anyway, no DNS servers will be entered.

At the "Miscellaneous Network Settings" screen, enter the "Gateway" and then select "Ok".

Action	At the Miscellaneous Network Settings screen, enter the "Gateway", then select "Ok" and press enter

The installer will move on to the hostname configuration screen.
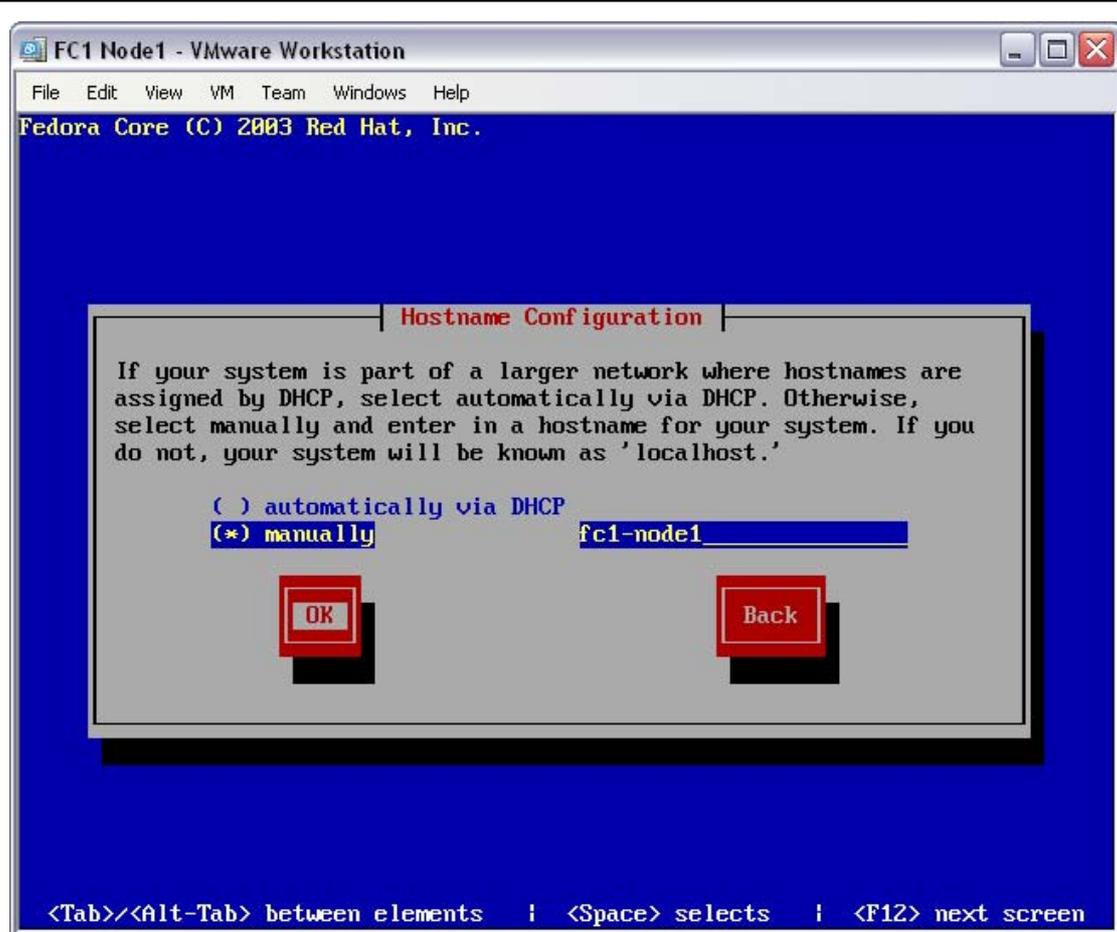
With no DHCP server in this network, the hostname will be entered manually. The actual hostname is arbitrary so make it meaningful to your situation.

At the "Hostname Configuration" screen, select "manually", enter the hostname and then select "Ok".

Action	At the Hostname Configuration screen, select "manually", enter the hostname, then select "Ok" and press enter

The installer will move on to the firewall screen.
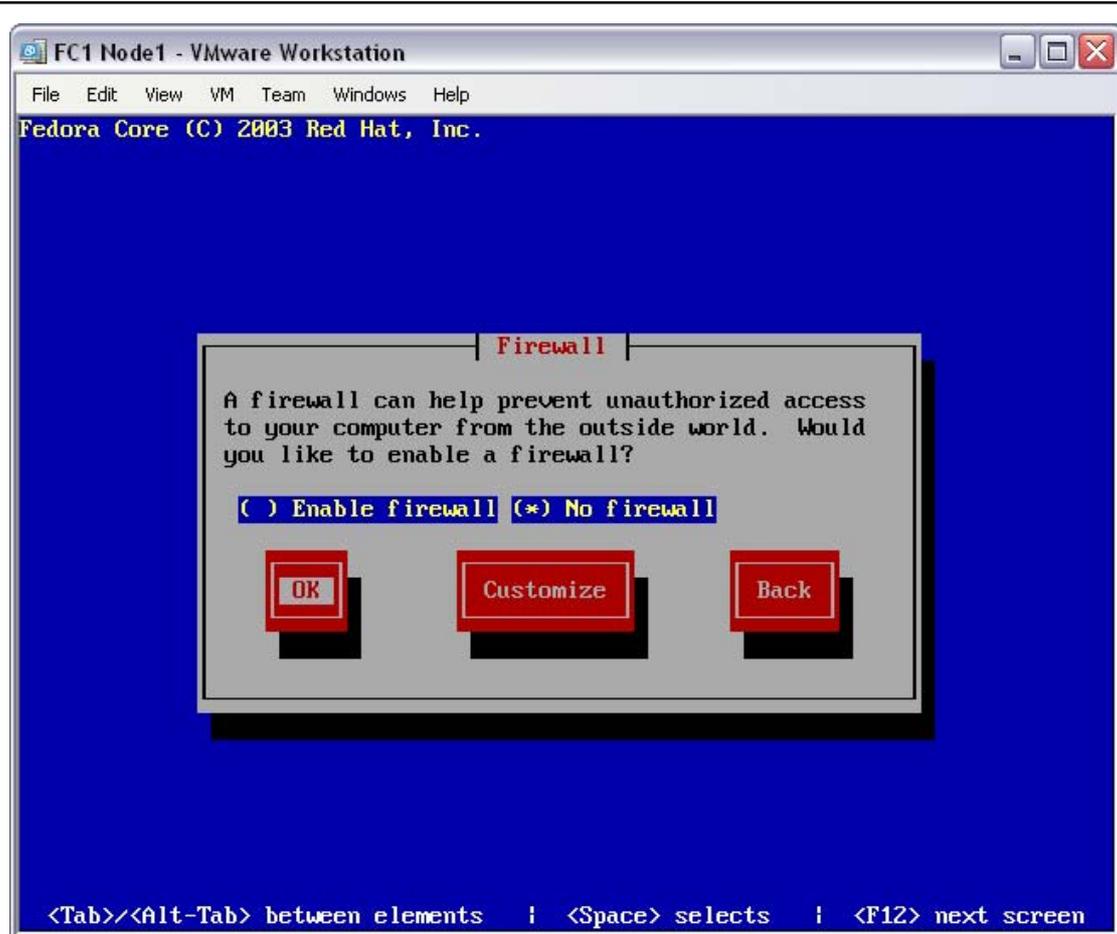
To keep this test as basic as possible, no firewall will be installed. This is a valid configuration for any private cluster network, but is considered High Risk in multi-user environments.

At the "Firewall" screen, select "No firewall" and then select "Ok".

Action	At the Firewall screen, select "No firewall", then select "Ok" and press enter

The installer will move on to the firewall warning screen.
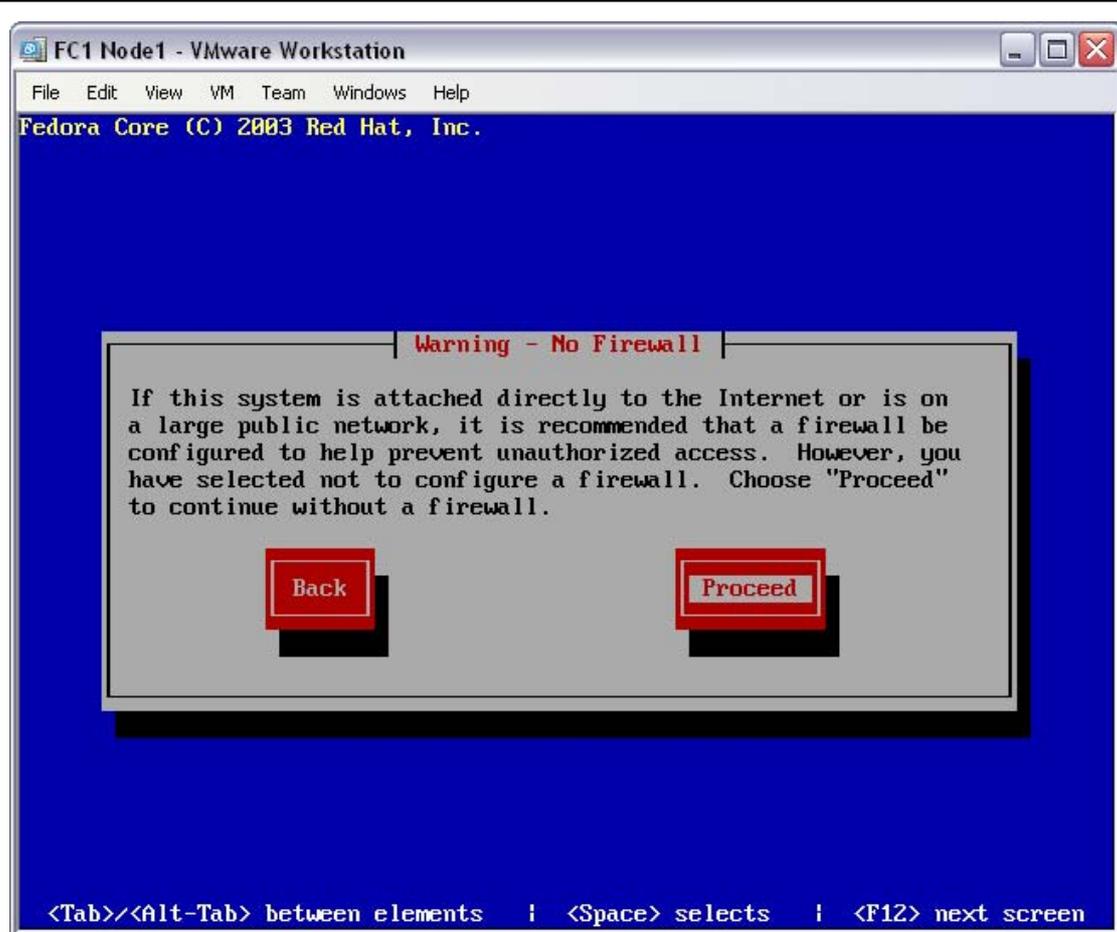
Rightly, the installation program is warning you that you have no firewall configured. See above for the configuration reasoning.

At the "Warning – No Firewall" screen, select "Proceed".

Action	At the Warning – No Firewall screen, select "Proceed" and press enter

With the network and firewall configuration established, the Yarrow installation program will now begin to configure the time, system (root) password and packages to be installed on this computer.

4.5   Configure the time, system password, and installation packages

This is the final stage of the Yarrow build process. This section of the installation will configure additional language support, time, the system (root) password, and any packages that are to be installed on this computer.

The "Language Support" screen will be displayed.
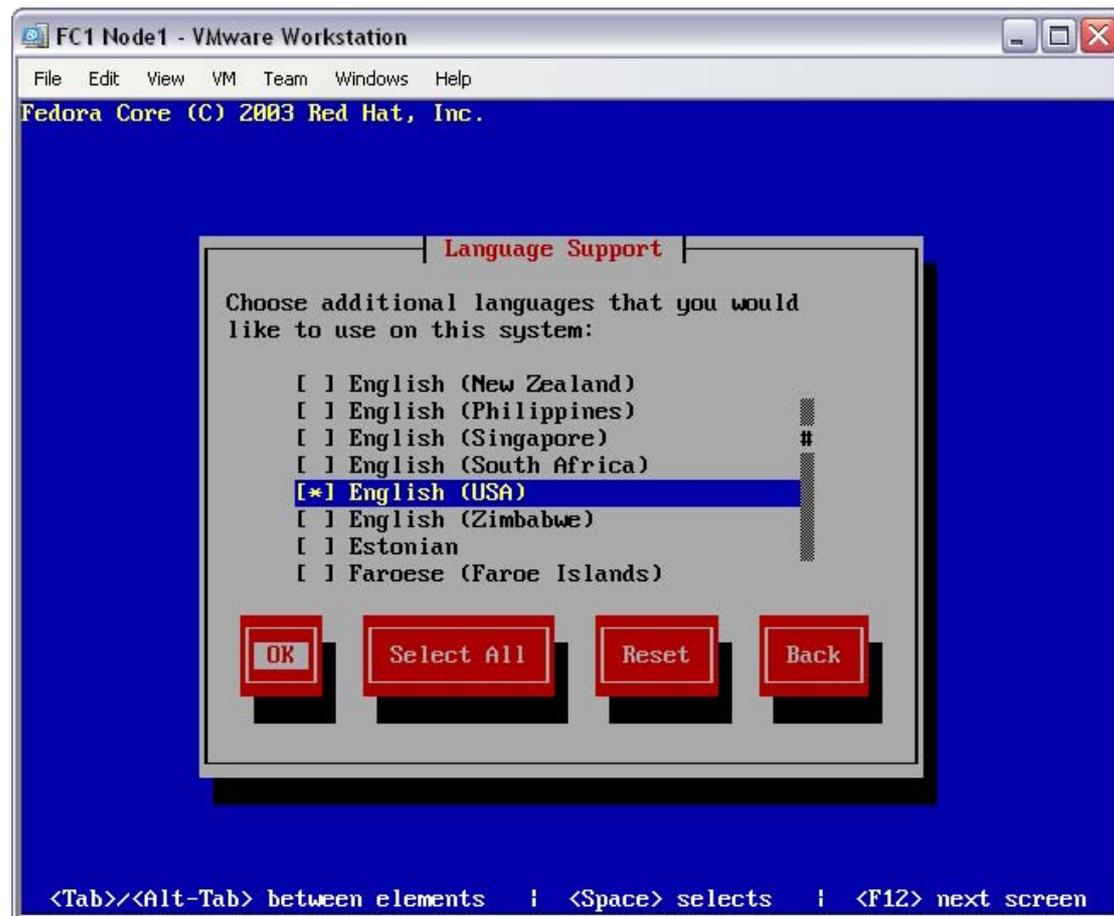
As this document has been written in English, this will be used as the language default. At the "Language Support" screen, select "English (USA)", then "Ok".

Action	At the Language Support screen, select "English (USA)", then select "Ok" and press enter

The installer will move on to the time zone selection screen.
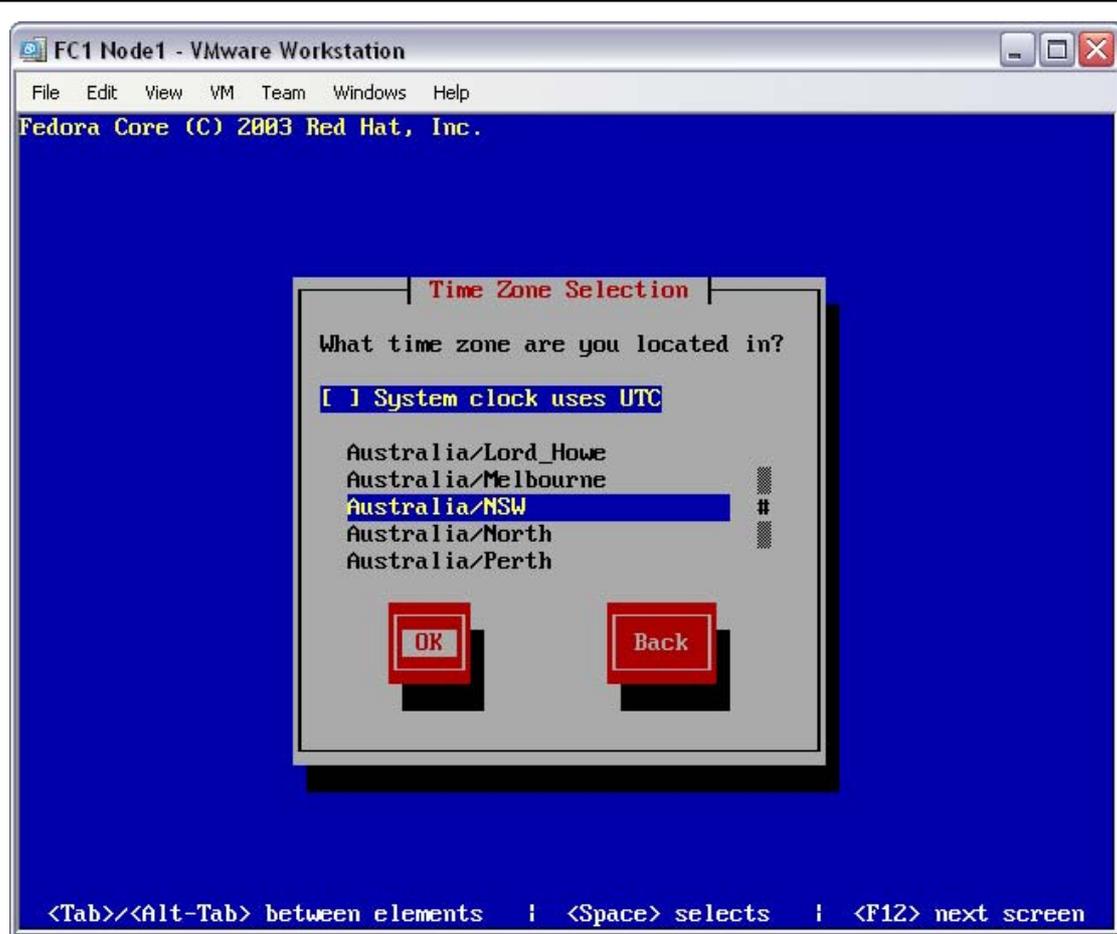
As this document has been written in Australia, the local time zone has been selected. At the "Time Zone Selection" screen, select "Australia/NSW", then "Ok".

Action	At the Time Zone Selection screen, select "Australia/NSW", then select "Ok" and press enter

The installer will move on to the root password configuration screen.
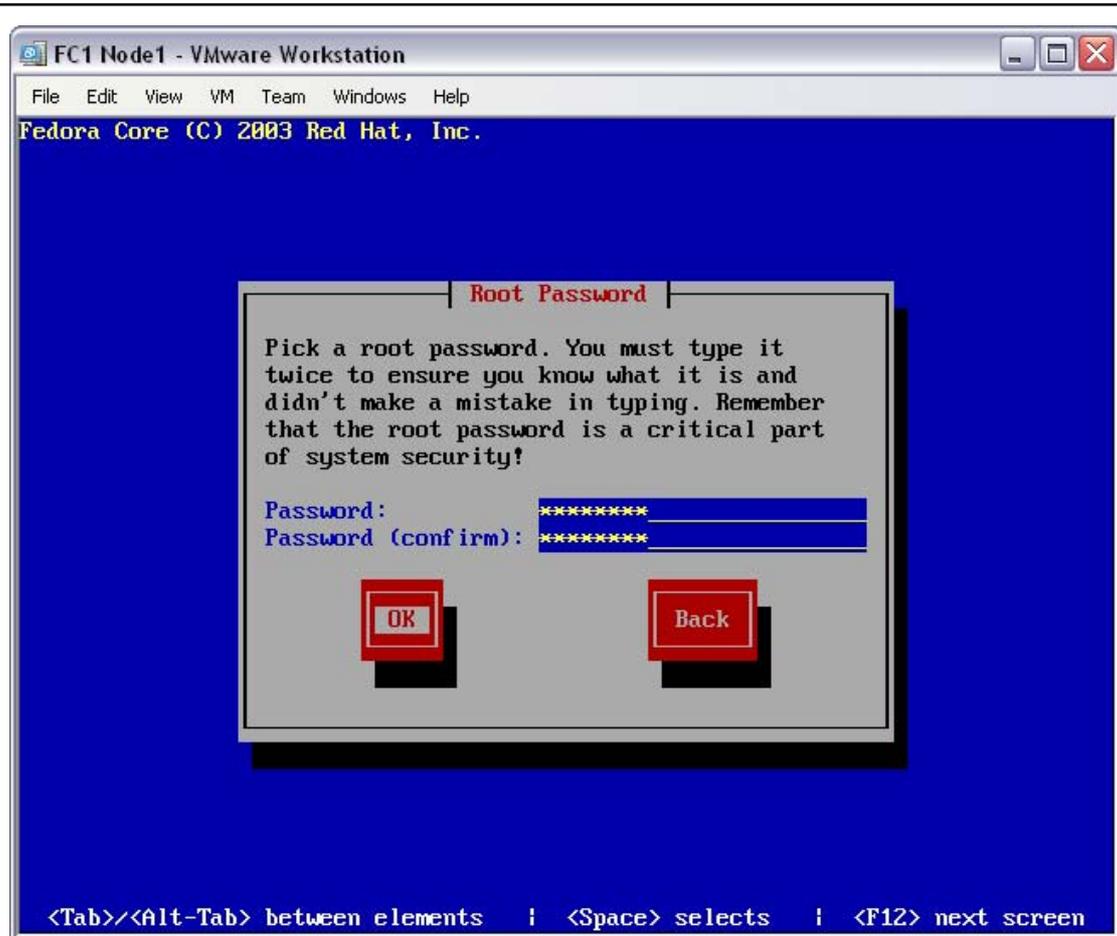
The system (root) password is arbitrary. Select a password that is agreeable with your local password policy. For this documentation, the password selected was "password" – it is not agreeable with any known password policy.

At the "Root Password" screen, enter the "Password" of "password", enter the "Password (confirm)" of "password" then "Ok".

Action	At the Root Password screen, enter the "Password" of "password", enter the "Password (confirm)" of "password", then select "Ok" and press enter

The installer will move on to the package group selection screen.
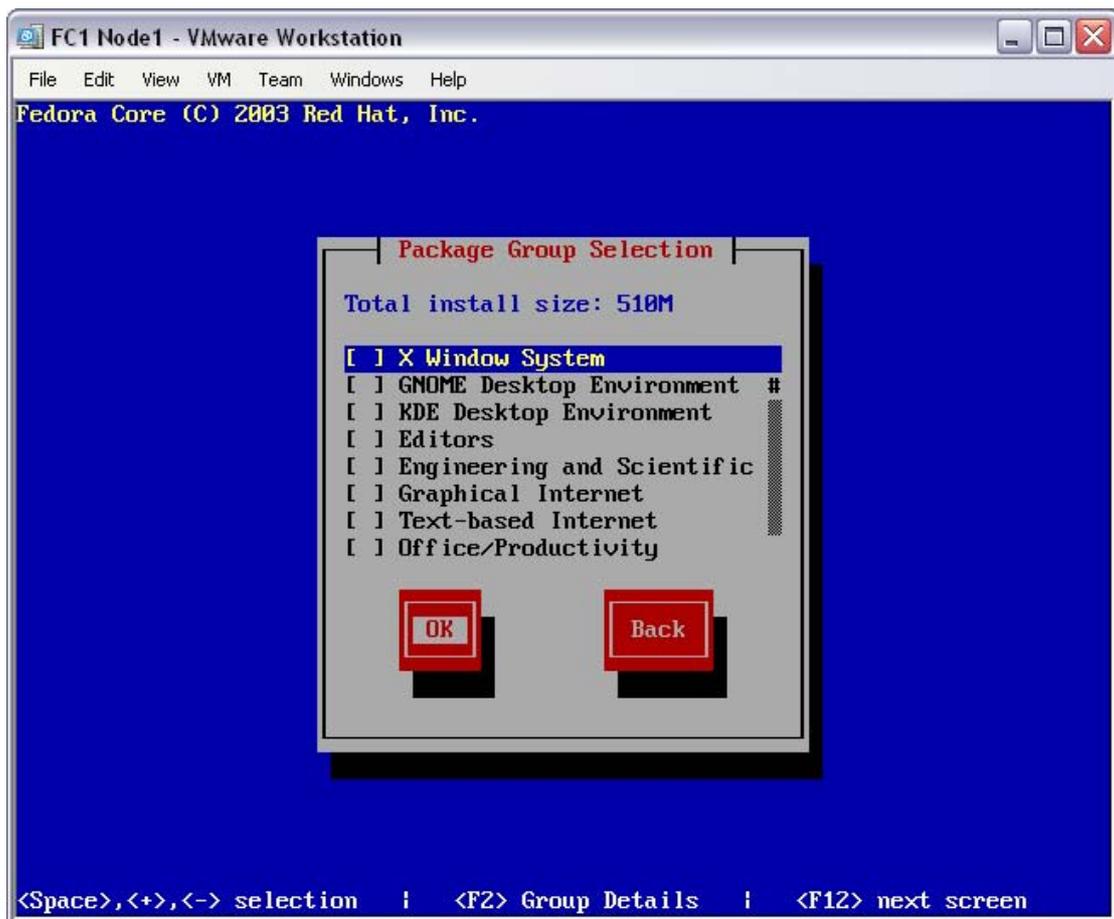
The openMosix cluster node requires no additional software. In this example, every package was disabled. Should you elect to enable additional packages, adjust the disk space requirements accordingly, and be prepared to download and burn additional Yarrow CD's.

At the "Package Group Selection" screen, de-select all options, then select "Ok".

Action	At the Package Group Selection screen, de-select all options then select "Ok" and press enter

The installer will move on to the installation start screen.
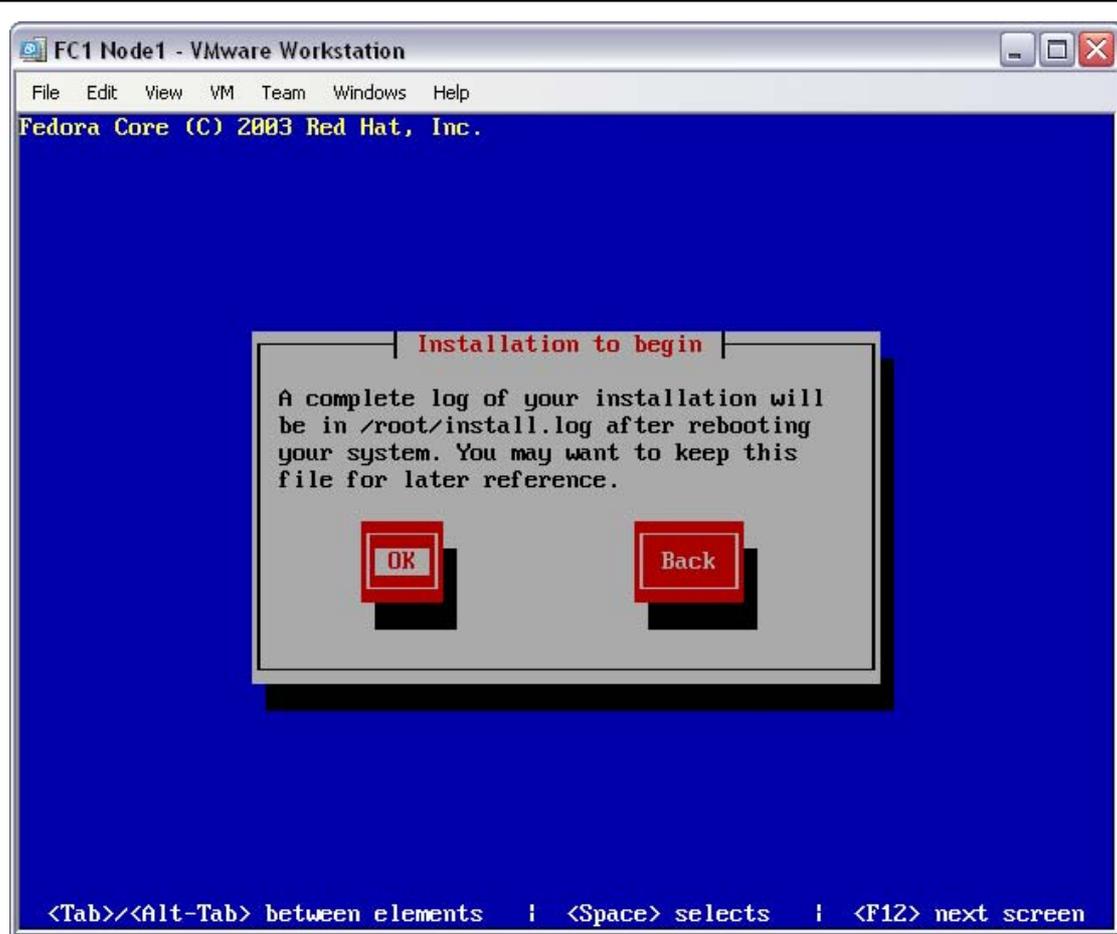
This information-only page is a notification of the installation log.

At the "Installation to begin" screen, select "Ok".

Action	At the Installation To Begin screen, select "Ok" and press enter

The installer will install the Yarrow Operating System – this should only take a few minutes. Once it has done that it will move on to the boot diskette screen.
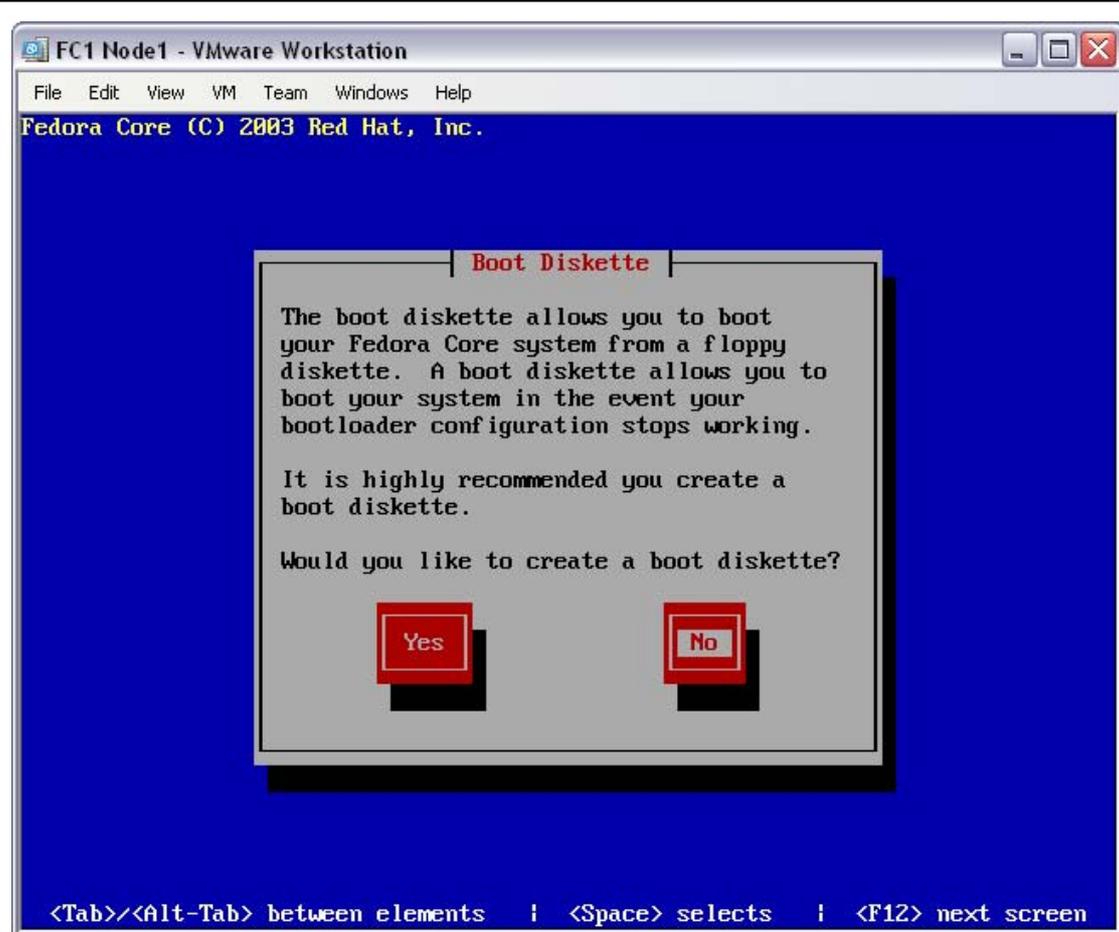
There is no need to create a boot diskette – these PCs are far too easy to rebuild from installation media.

At the "Boot Diskette" screen, select "No".

Action	At the Boot Diskette screen, select "No" and press enter

The installer has exhausted all configuration options. The final screen will be the completion screen.
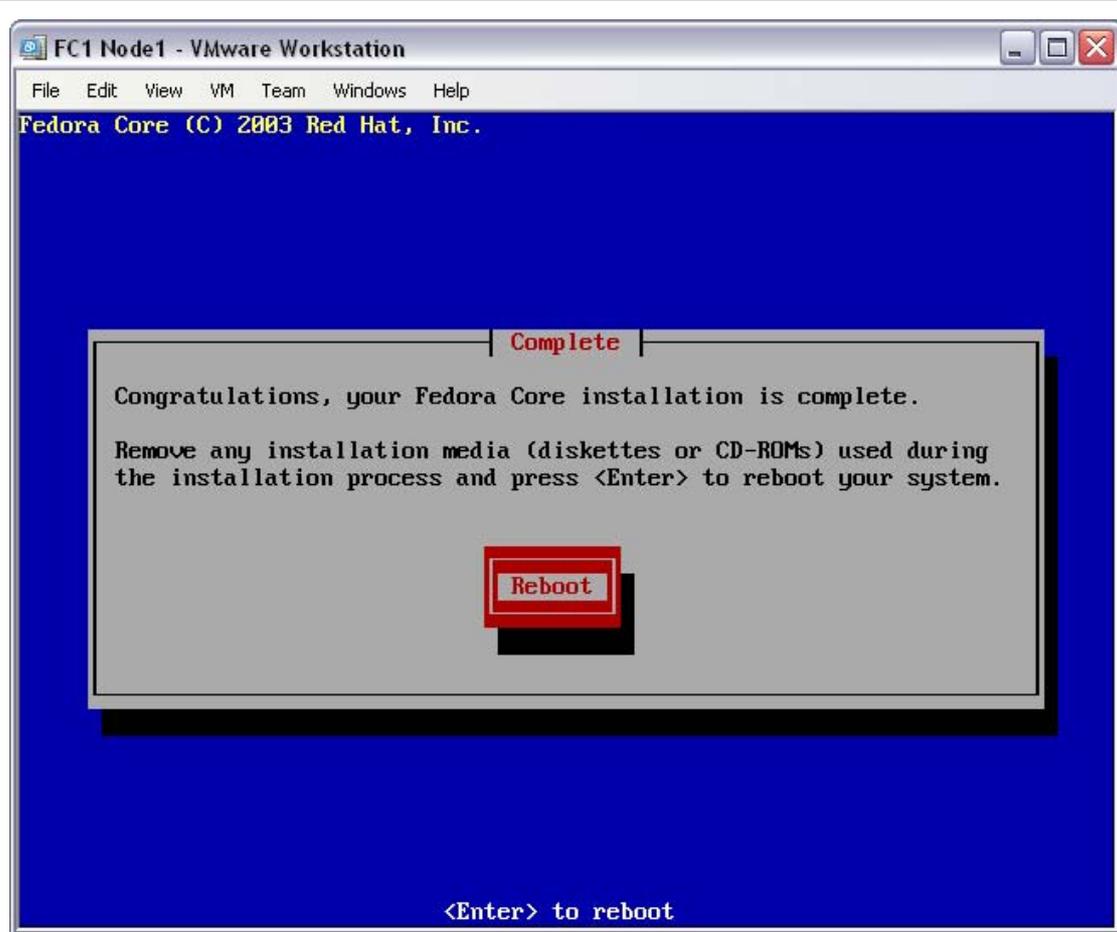
The installation is complete! At the "Complete" screen, press enter.

Action	At the Complete screen, press enter

The installer has completed, the PC is now rebooting. Next, you will turn this Fedora Core 1 (Yarrow) PC into an openMosix node.

4.6   Customise the new system

The PC will boot to the following boot menu.
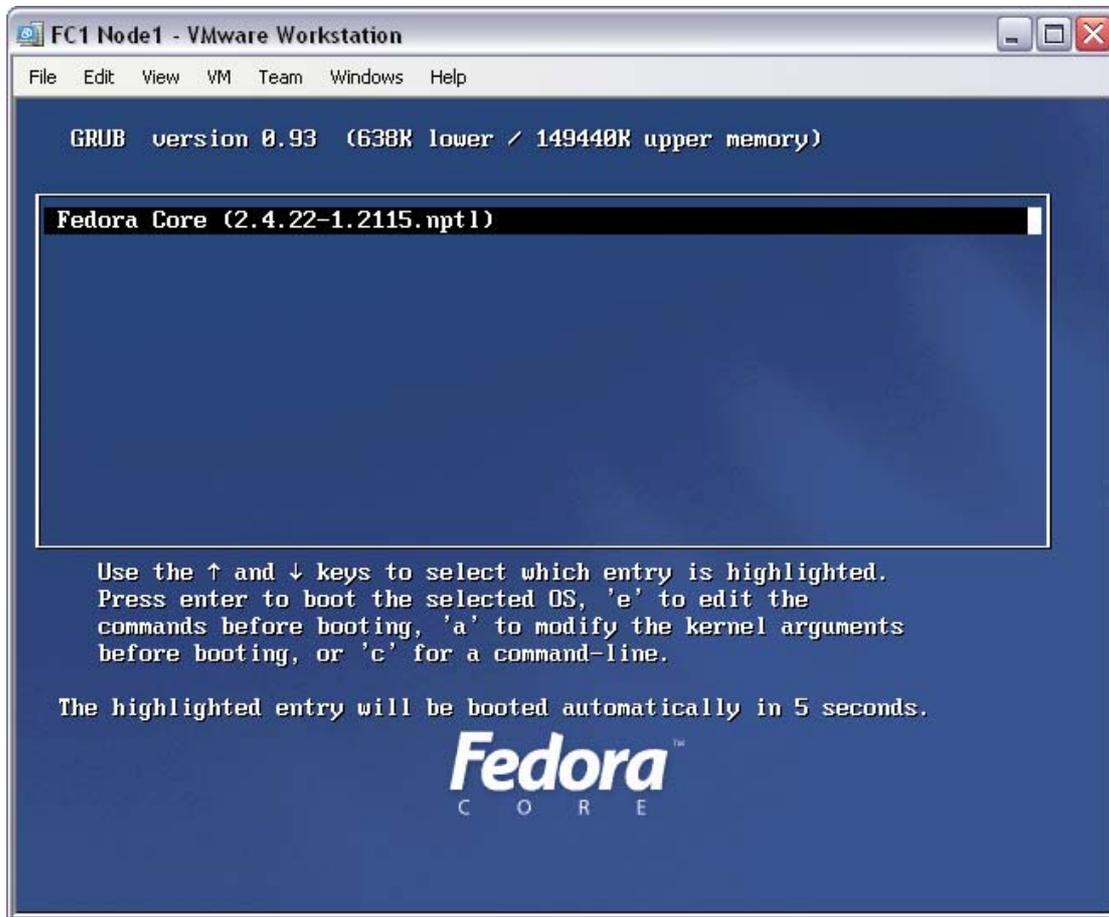
This boot menu will display on every boot. The default option is correct. You can either choose to let it time-out (after about 10 seconds) or you can press enter.

At the "Boot Menu" screen, press enter.

Action	At the Boot Menu screen, press enter

The PC will proceed to boot the Yarrow OS, where you can then login as root.

Action	At the login: prompt, enter the username "root", press enter, then the enter the root password "password", and press enter

You are now logged on as the super-user (root) on this system, and at the system prompt.
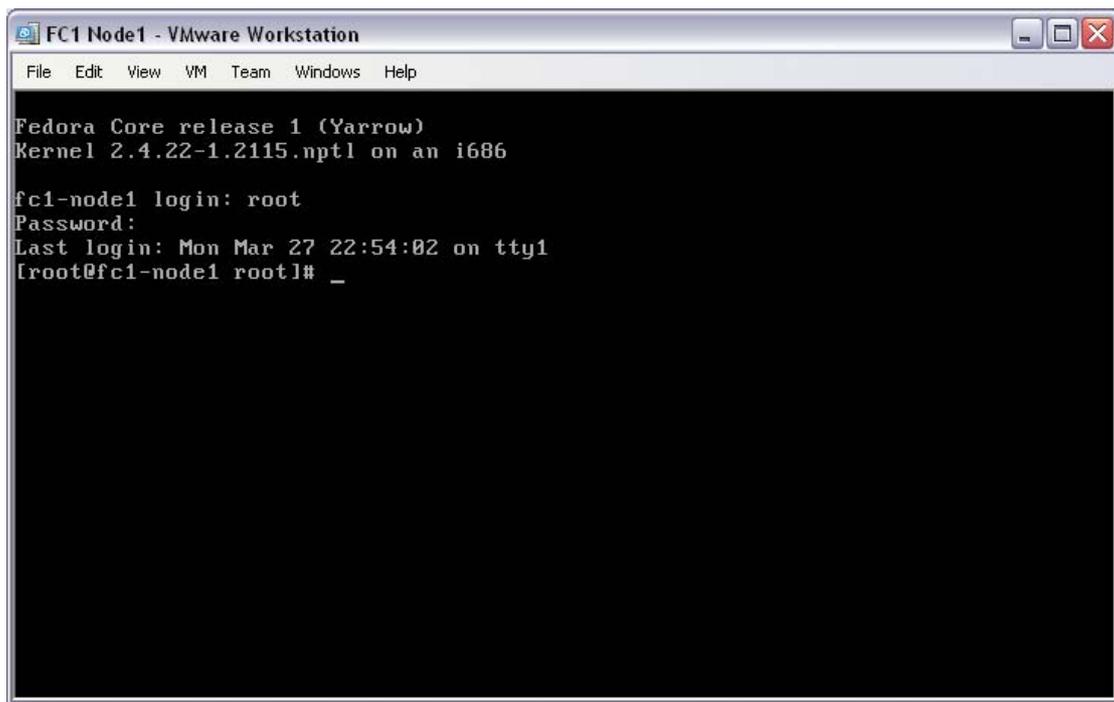
Despite the build type of "Custom" with no additional "packages", the default Yarrow installation runs a number of unnecessary services (daemons). These services can (and should) be disabled.

At the system prompt, enter the "chkconfig" commands required to disable the unneeded services.

Action	Enter the following commands at the system prompt, pressing enter after each; chkconfig acpid off chkconfig apmd off chkconfig atd off chkconfig gpm off chkconfig iptables off chkconfig isdn off chkconfig kudzu off chkconfig netfs off chkconfig nfs off chkconfig nfslock off chkconfig pcmcia off chkconfig portmap off chkconfig rhnsd off chkconfig saslauthd off chkconfig sendmail off chkconfig smartd off chkconfig yum off

Each command disables one service.

To see the effect of disabling these services, the PC will need to be rebooted.

At the system prompt, enter the "reboot" command.

Action	At the system prompt, enter the "reboot" command, and press enter

This completes the customisation of the default Yarrow installation. The PC will now reboot, and you can move on to the openMosix installation.

4.7   Install openMosix

The following steps will convert your new Yarrow PC into an openMosix node.

Once again the PC will boot to the usual boot menu.

The default option is correct. You can either choose to let it time-out (after about 10 seconds) or you can press enter.

At the "Boot Menu" screen, press enter.

Action	At the Boot Menu screen, press enter

The PC will proceed to boot the Yarrow OS, where you can then login as root.

Depending on how you've chosen to supply the two openMosix packages to your PC, this action may not apply.

For this example, the two openMosix packages have been downloaded from the Internet, onto a PC connected to the cluster LAN. Thus, the two openMosix packages are able to be "secure copied" to the new Yarrow PC.

At the system prompt of the Internet PC, enter "scp openmosix* root@192.168.100.11:/tmp/", accepting the new key and entering the new Yarrow system's root password.

Action	At the Internet PC's system prompt, enter the secure copy command "scp openmosix* root@192.168.100.11:/tmp/", and press enter; Accept the new SSH key, then enter the new Yarrow PC's root password "password", and press enter

The Internet PC will transfer the two openMosix packages to the new Yarrow PC's /tmp directory.

Its time to returning to the new Yarrow PC to install the openMosix packages.

Install the openMosix kernel by entering the command "rpm –ivh /tmp/openmosix-kernel-2.4.26-openmosix1.i386.rpm".

Action	At the Yarrow PC's system prompt, enter the openMosix kernel installation command "rpm -ivh /tmp/openmosix-kernel-2.4.26-openmosix1.i386.rpm", and press enter

Install the openMosix tools by entering the command "rpm –ivh /tmp/openmosix-tools-0.3.6-2.i386.rpm".

Action	Then, at the system prompt, enter the openMosix kernel installation command "rpm -ivh /tmp/openmosix-tools-0.3.6-2.i386.rpm", and press enter

To make the openMosix kernel the default boot kernel, you will need to edit the boot loader. Use your favourite unix text editor – this document refers to "vi".

Action	At the system prompt, enter the boot loader configuration editor command "vi /etc/grub.conf", and press enter

The editor will then open the /etc/grub.conf file for editing.

With the text editor open on the boot loader configuration file (/etc/grub.conf) you can change the default kernel image. To do this, change the line "default=1" to "default=0", and save the configuration file.

Action	Within the text editor "vi", use the "arrow" keys to move the cursor to the "1" in the "default=1" line, then enter "cl" (for "c"hange "l"etter), then enter the number "0". To exit the program, saving the changes, press the "ESC" key, then enter ":wq" and press enter

The boot loader (Grub) now has the correct configuration file, but the installed Grub boot loader needs to be updated with the changes.
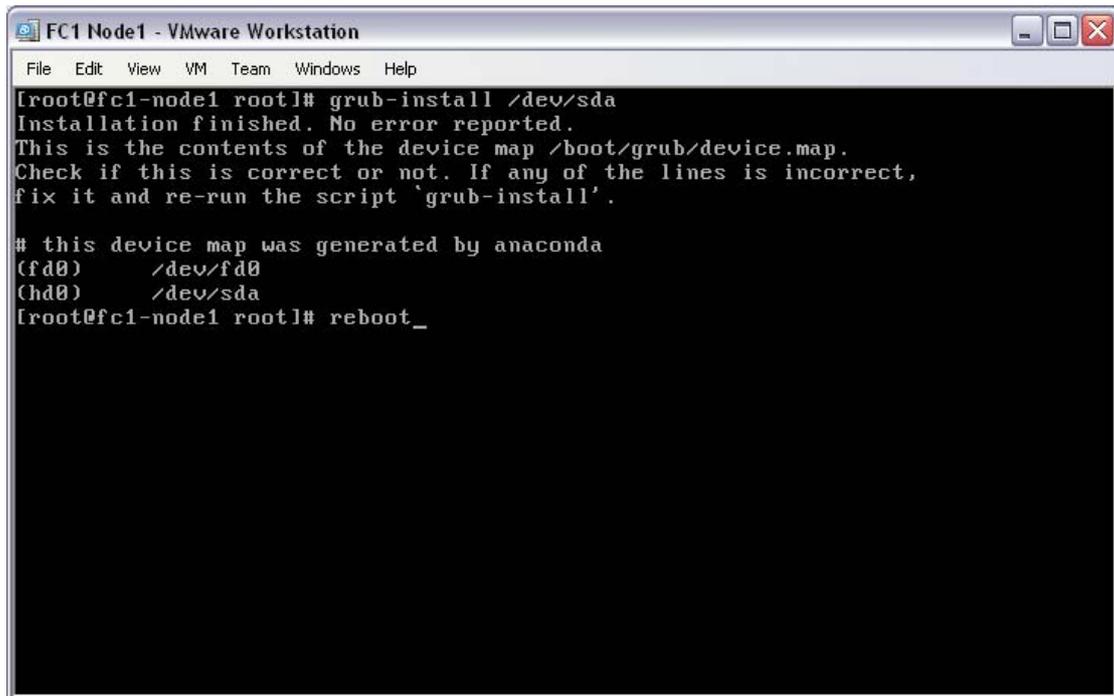
```
FC1 Node1 - VMware Workstation
File  Edit  View  VM  Team  Windows  Help
[root@fc1-node1 root]# grub-install /dev/sda
Installation finished. No error reported.
This is the contents of the device map /boot/grub/device.map.
Check if this is correct or not. If any of the lines is incorrect,
fix it and re-run the script `grub-install'.

# this device map was generated by anaconda
(fd0)     /dev/fd0
(hd0)     /dev/sda
[root@fc1-node1 root]# reboot_
```

Install the new configuration into the boot loader with the command "grub-install /dev/sda". Note that "/dev/sda" should be replaced with the value of the disk device as noted in the Boot Loader Configuration OS screen, for your installation.

Action	At the system prompt, enter the boot loader installation command "grub-install /dev/sda", then press enter

The boot loader (Grub) now has been installed with the correct configuration. The system is ready to be rebooted.

Action	At the system prompt, enter reboot command "reboot", then press enter

This new Yarrow system will now boot as a fully operational openMosix node.

4.8   Re-use these steps

These installation steps (all of section 4) will be repeated for each new PC that you would like to build as an openMosix node. All that is required is a new IP address and a new name to be selected, per PC/node.

Action	`Repeat all steps in section 4, with a second PC, to successfully complete the installation of two (2) openMosix nodes`

You must successfully complete the installation of at least two nodes before continuing past this point.

Action	`Do not continue past this point until you have two nodes`

5   Building the cluster

5.1   Cluster construction notes

Please note that the following steps are not mandatory. They have been included to provide a means for you to validate the successful operation of your new cluster, and to show you how the cluster is formed, automatically, from a number of nodes on a single LAN segment (or two nodes on a cross-over cable).

This section does assume that you have built two (2) nodes, per the instructions in the previous section. The first node is fc1-node1 at 192.168.100.11, and the second is fc1-node2 at 192.168.100.55.

5.2 Build the cluster

Start with both nodes powered off.

Boot the first node, and wait until it displays the boot menu. If the node has been built correctly, the default boot option will be the openMosix kernel for your Yarrow OS.

The default option is correct. You can either choose to let it time-out (after about 10 seconds) or you can press enter. At the "Boot Menu" screen, press enter.

Action	At the Boot Menu screen, press enter

The PC will proceed to boot the Yarrow OS, where you can then login as root.

The "openMosix map" is the record that details what nodes are included in the cluster, by IP address. The map itself is stored within the openMosix kernel. To see the openMosix map, at the system prompt, run the command "showmap".

Action	At the system prompt, enter the command "showmap", press enter

As only one node has been booted on this LAN, the map will show one IP address with a count of 1 node – this node.

Shutting down the first node, and repeating the boot, logon and showmap command sequence on the second node, you will see that there is only one node here, too; the local node.

Action	Shut-down the first node, from its system prompt, with the following command "shutdown -g0 -y -i0", and press enter; boot the second node, login to it as root, then at its system prompt, enter the command "showmap", press enter

As only one node has been booted on this LAN, the map will show one IP address with a count of one node – this node.
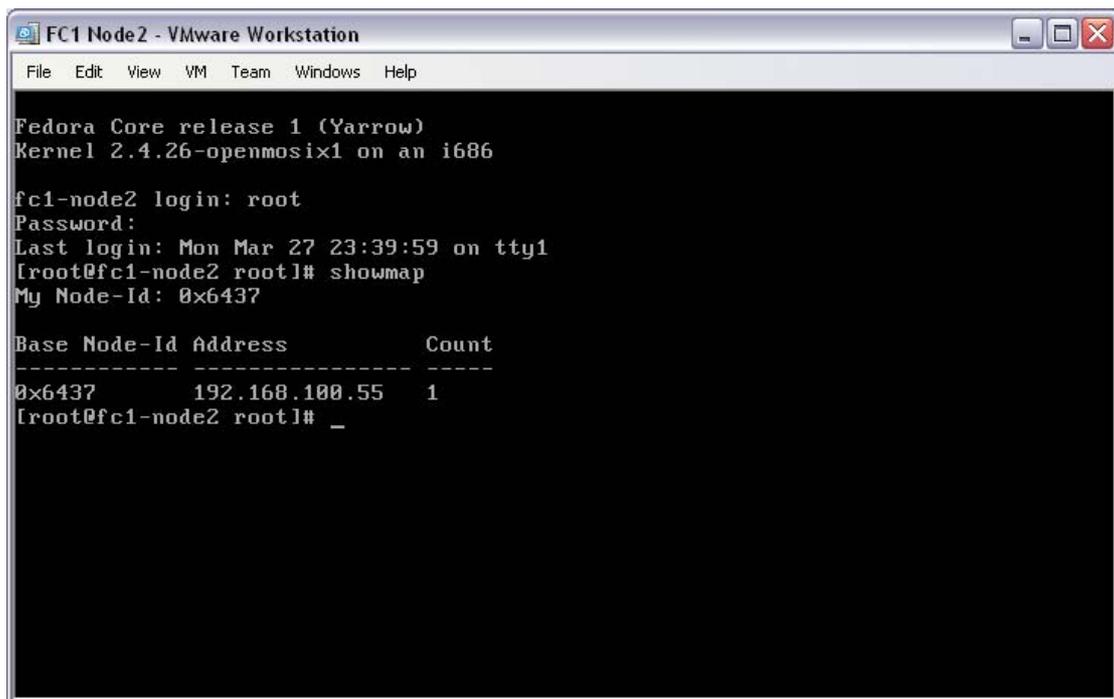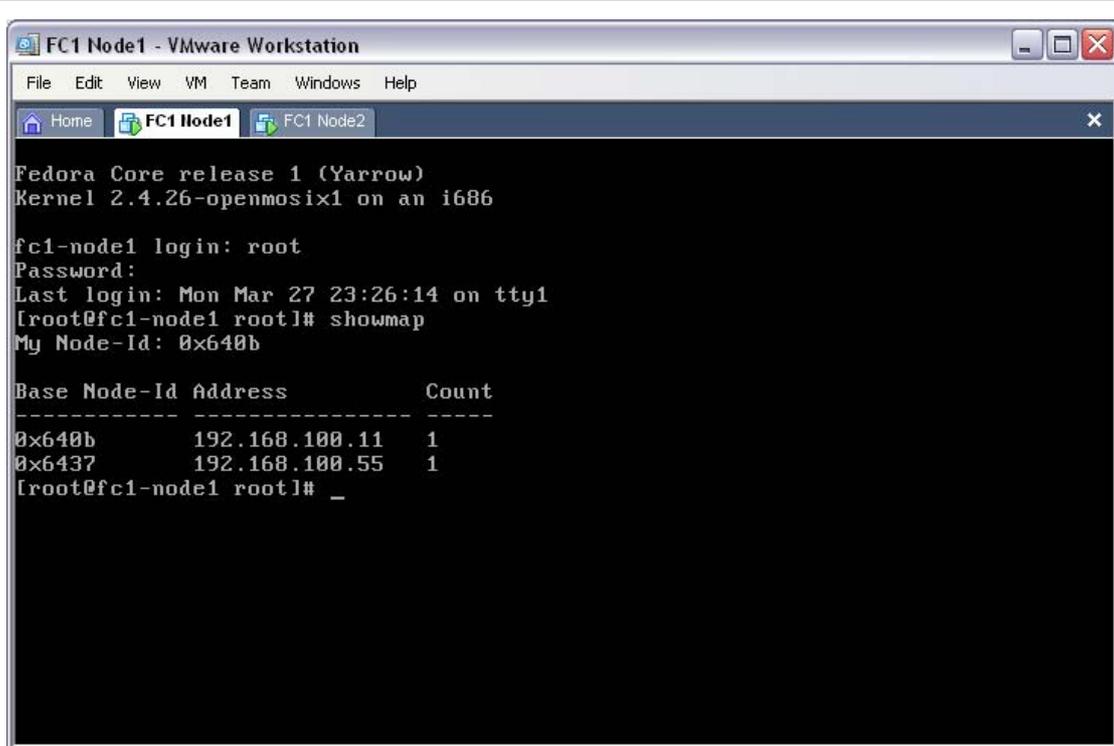
```
FC1 Node1 - VMware Workstation                                    _ □ ✕

 File   Edit   View   VM   Team   Windows   Help

 ⌂ Home   🖥 FC1 Node1   🖥 FC1 Node2                                  ✕

Fedora Core release 1 (Yarrow)
Kernel 2.4.26-openmosix1 on an i686

fc1-node1 login: root
Password:
Last login: Mon Mar 27 23:26:14 on tty1
[root@fc1-node1 root]# showmap
My Node-Id: 0x640b

Base Node-Id Address            Count
------------ ---------------- -----
0x640b       192.168.100.11   1
0x6437       192.168.100.55   1
[root@fc1-node1 root]# _
```

Leaving the second node alone, boot the first node. By the time you have logged in to the system as root, and executed "showmap", you should find that two nodes have been recorded in the node's cluster map.

Action	Boot the first node, logon, and then, from that node's system prompt, enter the following command "showmap", and press enter

As both nodes have been booted on this LAN, the map will show two IP addresses with a count of 1 node each – this node (the first node) and the other node (the second node).

Returning to the second node, an openMosix kernel message should have been output to the screen, beginning "openMosix configuration changed". This message should show the node numbers and their IP addresses as logged at the moment of discovery.

Note the two IP addresses, one for the local node (the second node) and one for the other node (the first node).

Staying with the second node, running "showmap" will show the kernel's openMosix map – confirming that there are now two nodes in the openMosix map on both nodes.

Action	At the system prompt, enter the command "showmap", press enter

As both nodes have been booted on this LAN, the map will show two IP addresses with a count of 1 node each – this node (the second node) and the other node (the first node).

Both nodes must have the same cluster map. The example cluster has met that prerequisite. The next step is to test the cluster, and its process migration.

5.3 Test the cluster

Start with both nodes powered on. If you are testing your cluster from first principles then you should have successfully passed the "showmap" tests above.

For the purposes of this test, the selection of a node is arbitrary as either node will operate as a "home node". However, for ease of reference, return to the first node.

You are going to create a small perl script that will endlessly consume processor resources. To create this script, open a new text file in your unix text editor with the command "vi /tmp/omtest.sh".

Action	On the first node, at the system prompt, enter the editor command "vi /tmp/omtest.sh", press enter

This will cause the editor to open a new editor window for the file /tmp/omtest.sh.
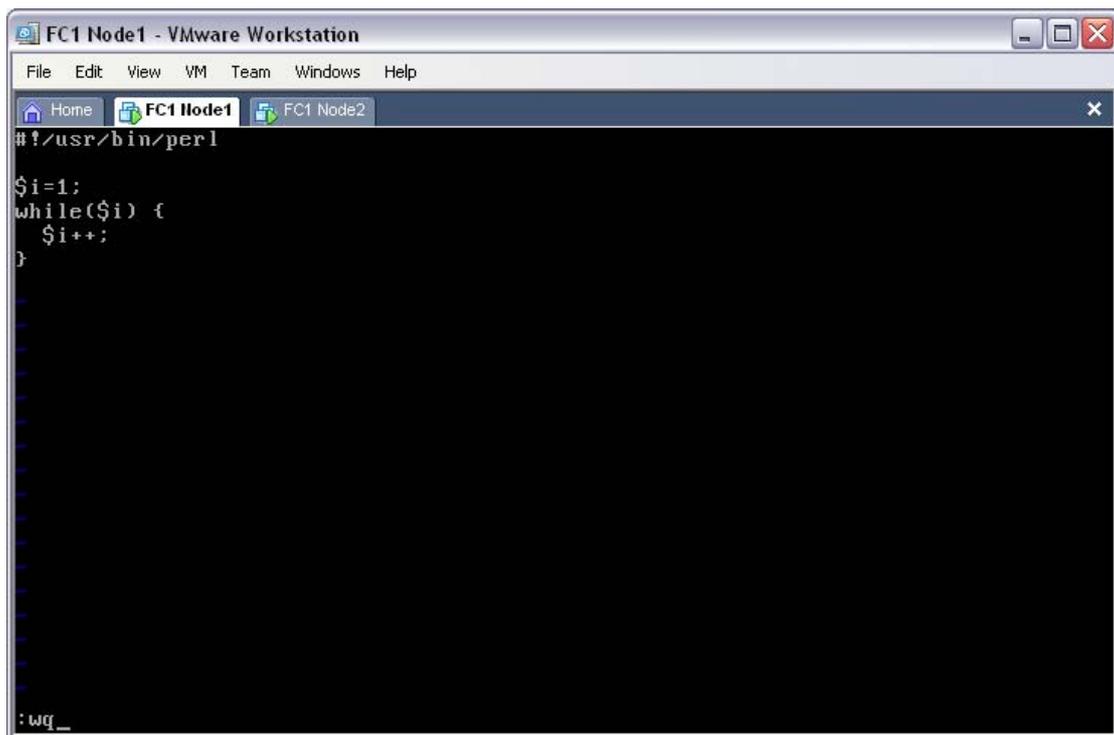
With the text editor open on the new script file (/tmp/omtest.sh) you can insert the script commands. To do this, press "i", enter the script as shown, then save by pressing "ESC", ":wq".

Action	Within the text editor "vi", enter "i" (for "i"nsert), then type the following seven lines, pressing enter at the end of each line;
	
	#!/usr/bin/perl
	
	$i=1;
	while($i) {
	  $i++;
	}
	
	To exit the script, saving the changes, press the "ESC" key, then enter ":wq" and press enter

The file /tmp/omtest.sh now contains a resource hungry perl script.
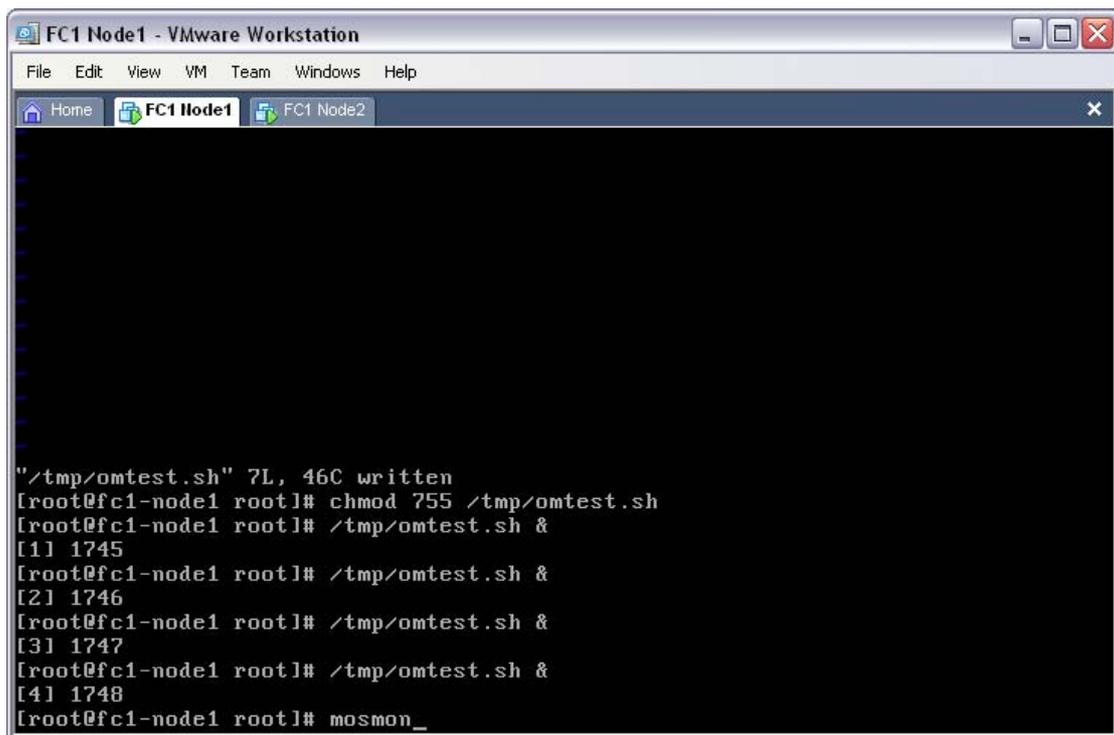
The new script is not executable, by default. This needs to be corrected; enter the following permission changing command "chmod 755 /tmp/omtest.sh".

Action	At the system prompt, enter the permission changing command "chmod 755 /tmp/omtest.sh", then press enter

The script is now ready to run. Running multiple instances of the script will help to overload the local node, forcing it to consider pushing one or more instances of the script to the "less busy" node.

Multiple instances can be run by using the shell "&" directive, to put the command into the background.

Action	At the system prompt, enter the command "/tmp/omtest.sh &", and press enter; repeat this sequence for a total of four script launches

There should now be four running instances of "omtest.sh". This program, being very processor hungry should have some instances pushed over to the second node.

To see the load of each node in the cluster, from any node in the cluster, run the command "mosmon" – try this now, staying on the first node. Shown in this screen shot, the first node believes that both nodes are evenly distributing the load – indicating that there are two "omtest.sh" script instances on each node.

Action	At the system prompt (still on the first node), enter the command "mosmon", and press enter

You are now able to clearly see the load of your cluster, in a single screen. This process should be repeatable on any node, so try now on the second node.

Move to the second node. At the system prompt run the command "mosmon". You should see an identical load display to the first node.

Action	At the system prompt (on the second node), enter the command "mosmon", and press enter

You are now able to clearly see the load of your cluster, in a single screen; from either node.

Congratulations, you have just confirmed that your cluster is working completely.

6   Conclusion

This paper provides a basic, step-by-step process for installing a working openMosix cluster. It uses only an off-the-shelf Linux distribution and two openMosix RPMs, requiring no code modification or compiling whatsoever.

This process is repeatable. It requires no prior openMosix experience.

While this documentation is not intended to produce a production cluster, it is hoped that it will provide a solid point from which to help some users perform cluster configuration or cluster network debugging. It is hoped that this document will help most new openMosix users to understand the openMosix node and cluster configuration in a "clean" environment, allowing them to help themselves – to adapt a working model to their own environments.

If this paper saves one person the frustration of debugging a foreign operating environment in a foreign network environment, then it has been worth every page.

7   References

7.1   Distributions

7.1.1   Fedora Core 1 (AKA: Yarrow)

http://download.fedora.redhat.com/pub/fedora/linux/core/1/

7.2   Software

7.2.1   openMosix

http://www.openmosix.org/

8 Contact

8.1 Additions, Modifications and Deletions

For changes to this document, please refer to the author and revision history blocks in the control page. Please report errors or omissions to the author.

8.2 Consultation

If you would like to discuss openMosix installation or other concepts related to this white paper, then please contact the author;

Ian Latter

Late night coder ...

Midnight Code

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