

## 1.2.1

### IP Addressing

```
[root@localhost root]# ifconfig
eth0      Link encap:Ethernet HWaddr 00:50:56:42:BA:D4
          inet addr:198.150.10.250 Bcast:198.150.10.255 Mask:255.255.255.0
                  UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
                  RX packets:2483 errors:0 dropped:0 overruns:0 frame:0
                  TX packets:8 errors:0 dropped:0 overruns:0 carrier:0
                  collisions:0 txqueuelen:100
                  RX bytes:251313 (245.4 Kb) TX bytes:728 (728.0 b)
                  Interrupt:10 Base address:0x10a0

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:14 errors:0 dropped:0 overruns:0 frame:0
                  TX packets:14 errors:0 dropped:0 overruns:0 carrier:0
                  collisions:0 txqueuelen:0
                  RX bytes:1048 (1.0 Kb) TX bytes:1048 (1.0 Kb)

[root@localhost root]# _
```



## Laboratory Overview

### **Objective**

At the end of this lab, students will have a basic understanding of IP Addressing. This will include an understanding of IP Address classes, subnetting and how these concepts are applied to a network. The student will also learn IP configuration on the Windows and Linux operating systems.

### **Information for Laboratory**

- A. Students will learn how Subnet masking is applied to an IP Address to create networks.
- B. Student will use “calc” in Windows to work with number system conversions.
- C. Students will use the windows “Network Connections” tool to configure IP Address information on the Windows operating system.
- D. Students will use the “netconfig” tool to configure IP Address information on the Linux operating system.

### **Student Preparation**

The student will have completed requisite reading. The student will require paper for notes and should be prepared to discuss the exercises upon completion.

### **Instructor Preparation**

Before class, the instructor or a lab assistant will prepare a computer running Red Hat Linux version 8.0 or greater and a computer running Windows NT 4.0 or greater. Network connectivity is required to both computers. An IP address range must be made available for the student computers.

### **Estimated Completion Time**

45 Minutes



Most modern networks have standardized on TCP/IP (Transmission Control Protocol / Internet Protocol) as the networking protocol of choice. Networks using the TCP/IP protocol route messages based on the IP address of the destination. Standardizing networking protocols allows different vendor products to more easily communicate together.

The Internet Protocol operates at network-layer (Layer 3) and contains addressing information and some control information that enables packets to be routed. The format of an IP address is a 32-bit binary number written as four decimal numbers separated by periods. Each of the numbers represents an eight bit binary number with a value between zero and 255. Every IP address is made up of two parts, one identifying the network and one identifying the node or device.

## IP Addressing:

### Address classes

There are three different standard address classes used to identify networks in IP. Each of these classes can be identified by the first four binary digits of the first number in the address.

#### Diag 1:

	Binary	Decimal	Subnet mask
<b>Class A address</b>	<b>0xxx   xxxx</b>	<b>1-126</b>	<b>255.0.0.0</b>
<b>Class B address</b>	<b>10xx   xxxx</b>	<b>128-191</b>	<b>255.255.0.0</b>
<b>Class C address</b>	<b>110x   xxxx</b>	<b>192-223</b>	<b>255.255.255.0</b>



Each class of IP address has a default subnet mask. The subnet mask is used to separate the network portion of an IP address from the host portion. An analogy you can use is the network portion of the address is the street you live on. The host portion of the address is your house number on that street. Subnet mask bits set to "1" indicate the network portion; bits set to "0" indicate the host portion.

	<b>Network</b>	<b>Host</b>
	=====	+++++
<b>Class A</b>	<b>11111111.00000000.00000000.00000000</b>	<b>255.0.0.0</b>
	=====	+++++
<b>Class B</b>	<b>11111111.11111111.00000000.00000000</b>	<b>255.255.0.0</b>
	=====	+++++
<b>Class C</b>	<b>11111111.11111111.11111111.00000000</b>	<b>255.255.255.0</b>

Performing a logical bitwise AND between the IP address and subnet mask results in the network address. The logical AND operation compares 2 bits and if they are both "1", then the result is "1", otherwise, the result is "0".

#### Diag. 2

1	1	0	0
1	0	1	0
--	--	--	--
1	0	0	0



Diagram 3 represents an IP address with the subnet mask applied to extract the network address. The first two bits in the address are 11 indicating a Class C address (Line. 1). The Class C address has a default subnet mask of 255.255.255.0 (Line. 2). A logical bitwise AND leaves just the network portion of the address (Line. 3).

#### Diag. 3

11000000.10101000.00110010.01100100	192.168. 50.100
11111111.11111111.11111111.00000000	255.255.255. 0
-----	-----
11000000.10101000.00110010.00000000	192.168. 50. 0

#### VLSM (Variable Length Subnet Mask)

The use of variable-length subnet masking (VLSM) allows you to customize your address space. In standard class full subnetting, the network boundary must be aligned with one of the octet boundaries (see Diag: 1). Using VLSM you can specify a network boundary anywhere within the IP address range.

#### Diag. 4

11000000.10101000.00110010.01100100	192.168. 50.100
11111111.11111111.11111111.11111000	255.255.255.248
-----	-----
11000000.10101000.00110010.00000000	192.168. 50. 96

#### Binary to Decimal conversion

To convert between the binary and decimal versions of the numbers you can use the windows calculator.

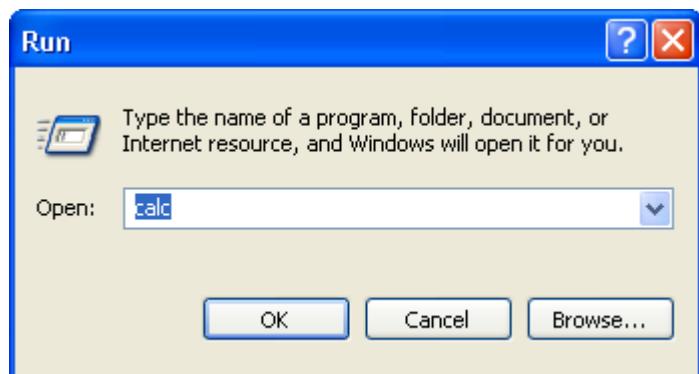


**Step 1:**

Click your start button and select “Run...”

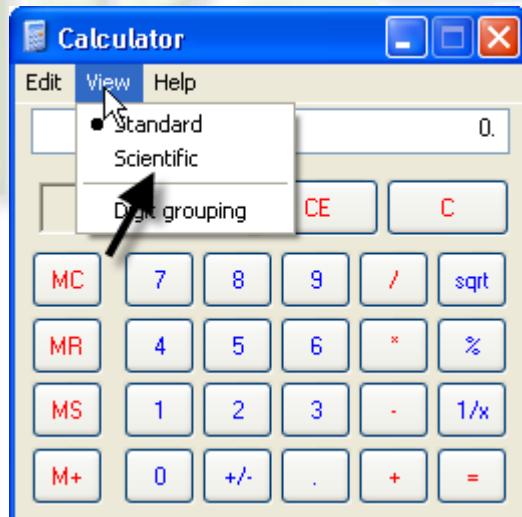
**Step 2:**

Type “calc” into the “Run” box. This will launch the windows calculator.



**Step 3:**

Click “View” from the main menu options and select “Scientific”.

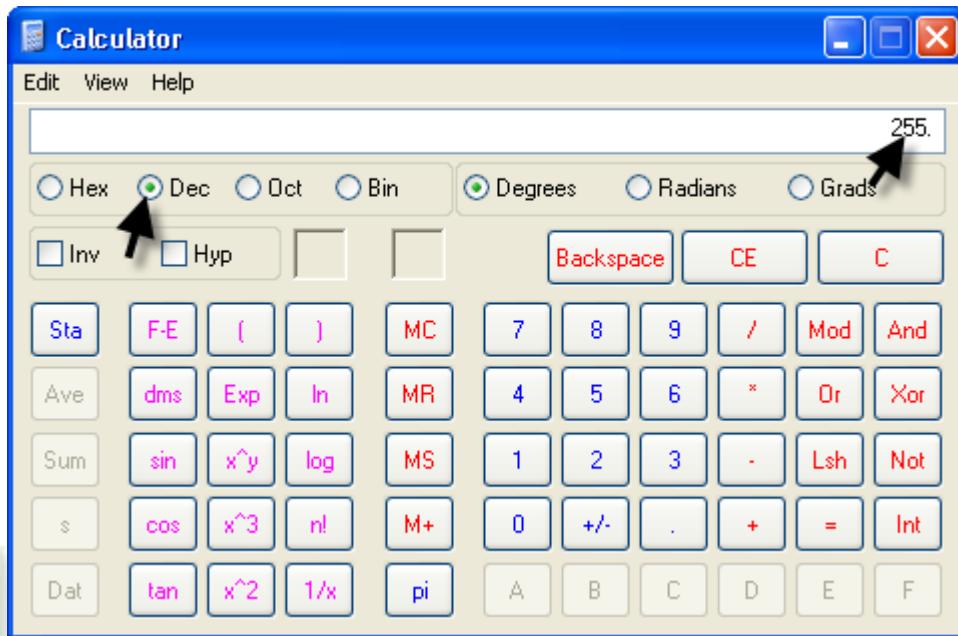


**Step 4:**

The Windows calculator has a set of buttons used for converting from one number system to another. To convert

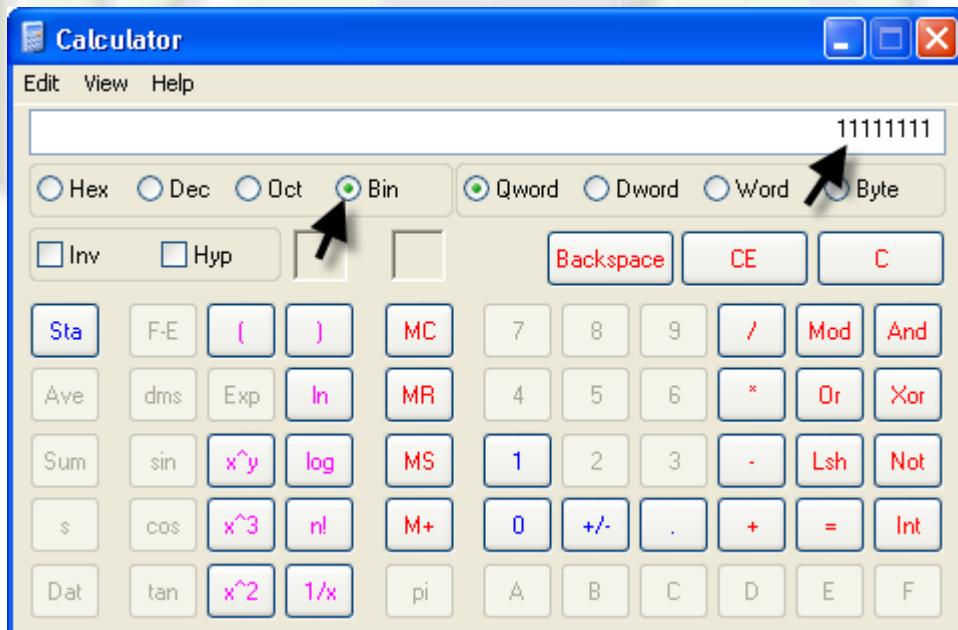


from Decimal to Binary select the “Dec” radio button and type in your decimal number.



### Step 5:

Click “Bin” and the binary equivalent to the decimal number is displayed in the number field.



Convert the following numbers to their binary equivalents.

Decimal	Binary
151	
224	
19	

**Step 6\*\*\*\*** After putting in each decimal number, convert it to binary, take a screen shot of it, save to a Word file and print it off for your instructor. Make sure you put your name on it.

The host portion of an IP address is used to identify a specific node within a network. Each device that is connected to the network must have an IP address to be able to communicate with the rest of the network devices. The following two procedures show you how to configure the IP address in the Windows and Linux operating systems.

### Windows network setup

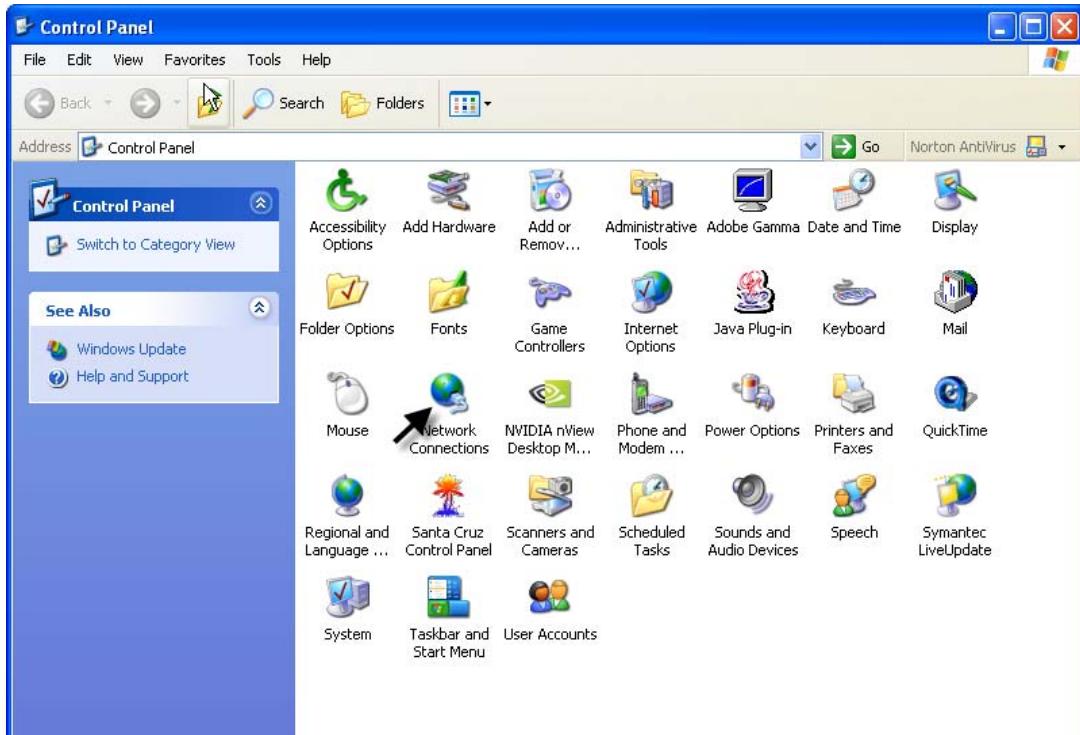
**Step 1:**

Click your start button and select “Control Panel”.

**Step 2:**

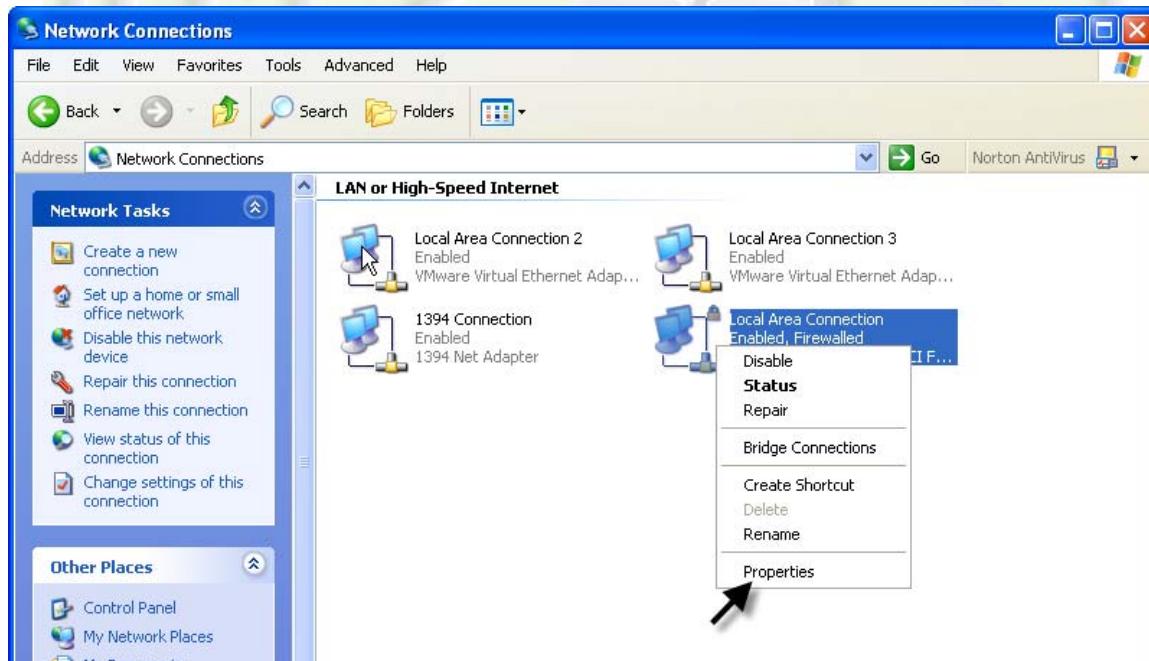
Double click on the “Network Connections” icon.





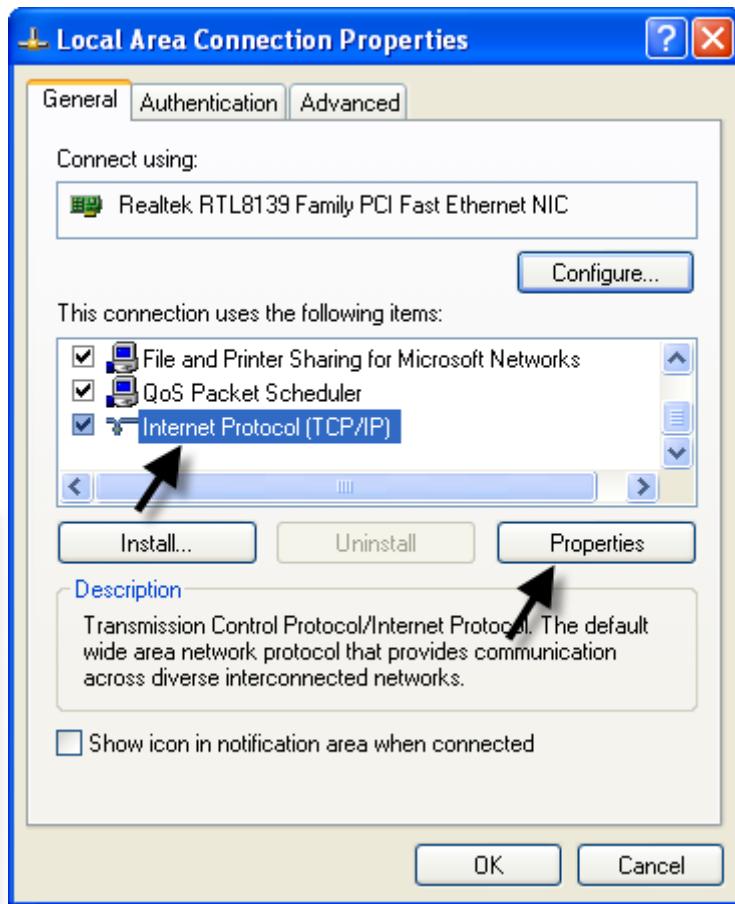
### Step 3:

Right click on “Local Area Connection” and select “Properties”.



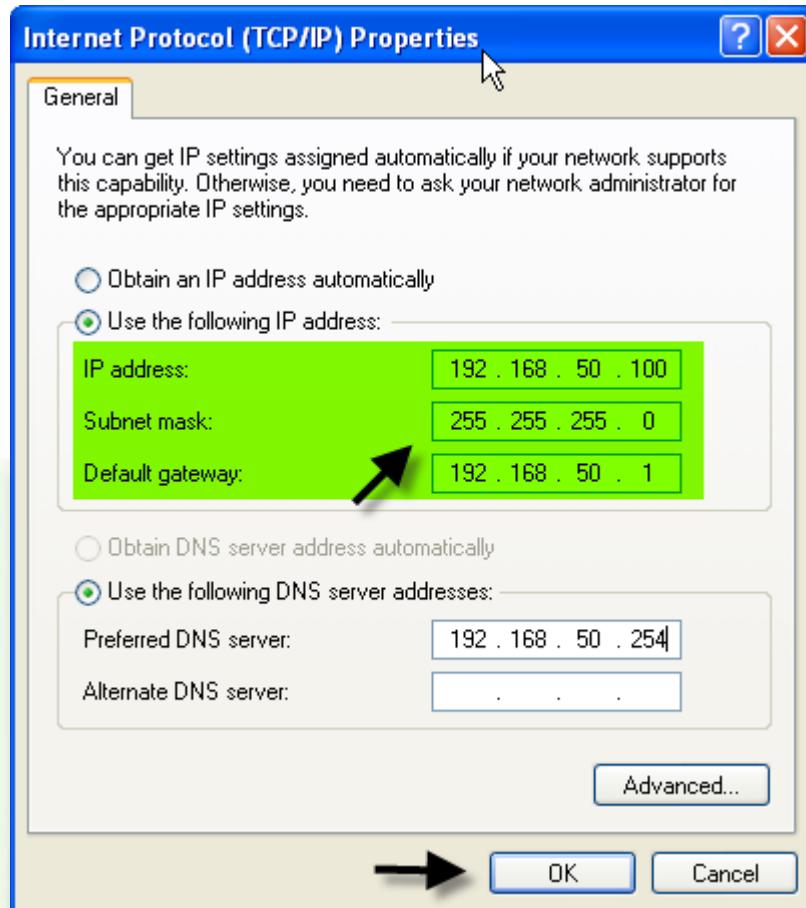
**Step 4:**

Select “Internet Protocol (TCP/IP)” from the list and click the “Properties” button.



### **Step 5:**

Type in your IP address, subnet mask, default gateway and name server (These will be assigned by your instructor). Select “OK” and hit enter.



### **Linux network setup**

#### **Step 1:**

Log in using the root account.

#### **Step 2:**

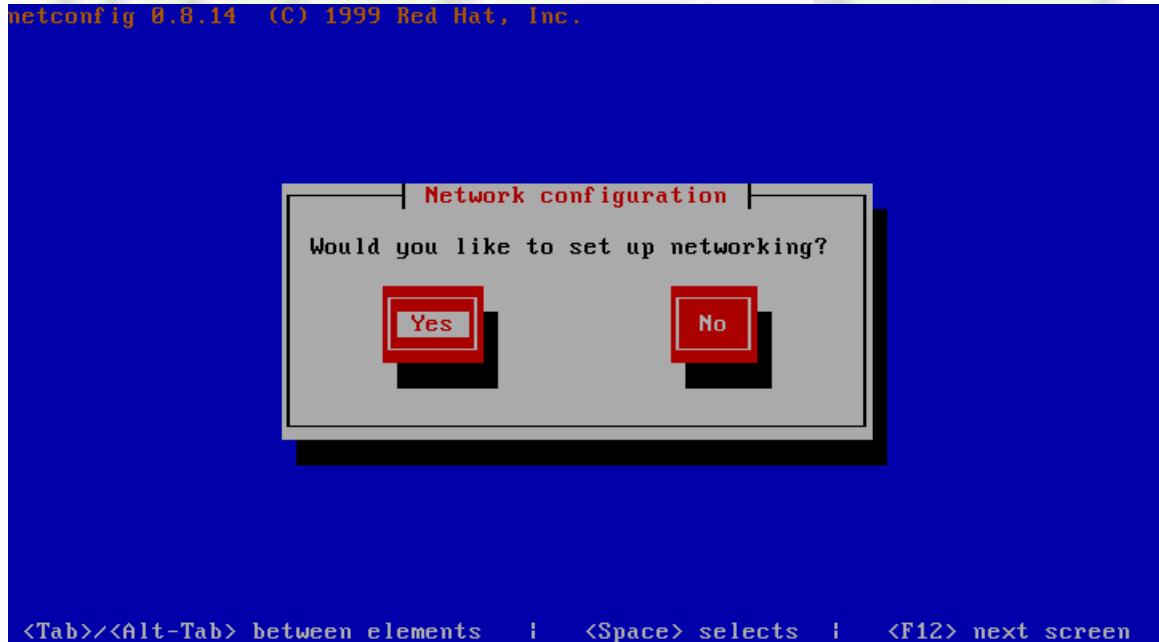
At the command prompt type “netconfig” and press enter.



```
[root@localhost root]# netconfig_
```

### Step 3:

When asked to set up networking, select “Yes” and press enter.

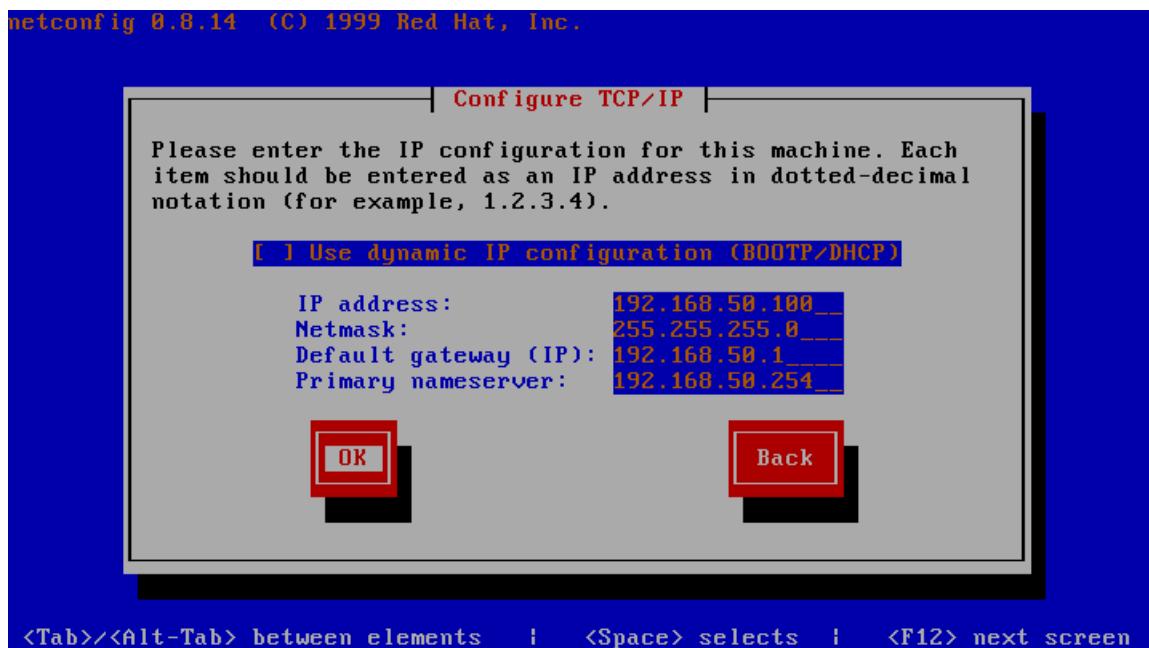


### Step 4:

Type in your IP address, subnet mask, default gateway and



name server (These will be assigned by your instructor). Select "OK" and hit enter.



### Step 5:

The screen will return to the command prompt when complete.



### Step 6:

You must reload the networking subsystem for your changes to



take effect. The easiest way to do this is to reboot the system. At the command prompt type “shutdown –r now”. When Linux reloads the new network settings will be in effect.

```
netconfig 0.8.14  (C) 1999 Red Hat, Inc.
```

```
[root@localhost root]# shutdown -r now
```



## Step 7:

After the system has restarted log in as root. Check the new network settings by typing “ifconfig” at the command prompt. You should see your setting listed under “eth0”.

```
[root@localhost root]# ifconfig  
eth0      Link encap:Ethernet HWaddr 00:50:56:42:BA:D4  
          inet addr:198.150.10.250 Bcast:198.150.10.255 Mask:255.255.255.0  
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1  
          RX packets:8632 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:4 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:100  
          RX bytes:834790 (815.2 Kb) TX bytes:168 (168.0 b)  
          Interrupt:10 Base address:0x10a0  
  
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:10 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:10 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:700 (700.0 b) TX bytes:700 (700.0 b)  
  
[root@localhost root]# _
```



## **Analysis:**

- 1) If you are a network administrator, how valuable are the techniques learned in this lab? In what situation(s) could you see using this? Be prepared to discuss your answer.
- 2) Why should you learn to use the command line tools in Linux instead of the graphical counterpart?

## **Summary Discussion**

A classroom discussion should follow the lab. Review the lab questions and your analyses as a group. Share your experiences and knowledge with the class.

## **If You Want To Learn More**

Do a search on the internet on IP addressing.

For additional information on setting up windows networking, search <http://www.microsoft.com/technet>.

For additional information on setting up Linux networking, Search <http://www.tldp.org>.

A good resource to learn more about subnetting is <http://www.ralphb.net/IPSubnet/>.



## **Appendix:**

The OS environment for this lab was Windows XP Professional, Version 2002, Service Pack 2 (8/04), and Red Hat Linux 9, which may be obtained from:

<http://www.microsoft.com>

-and-

<http://www.redhat.com>

-or-

<http://www.download.com>

