Name: _____ Section: _____

Lab #1 – Introduction
IC 322 – Computer Networks
Week 1

Instructions

This lab is to be completed individually unless otherwise noted. Collaborative conversations with regard to strategies and methods for accomplishing the goal of the lab are encouraged; however design and implementation must be the work of the individual student that is handing in the final product.

This lab is due one week from today at the beginning of the next lab.

The machines in your lab are all wired into the ACADEMY network, with network IP address 10.53.21.XXX. This lab will require disconnecting from the ACADEMY network and creating a separate network. In the last 10 minutes of lab time, regardless of your progress, all machines must be returned their pre-lab configuration by following the steps in Part 6 at the end of this document.

Changing the IP address requires specific user permissions on the machine. You should already have these permissions assigned to your user account. Notify the instructor immediately if you are unable to complete a task due to incorrect user permissions.

Part 1. The Physical Address

A computer is connected to a network by a **N**etwork **I**nterface **C**ard (NIC), also termed a *network adapter*. That is, the NIC is the physical interface between a computer and the networking medium. The networking medium, in turn, might be a wire, a fiber optic strand, or free space (in the case of wireless networks). Each NIC is given a unique physical address by its manufacturer. This is also called a media access control address, or MAC address. A MAC address is like a Social Security number, but for a NIC card.

Now that you know that your computer has a NIC with a unique address, let's find out what it is.

To pull up the list of available network connections on any Windows machine, open a console (Start, then type `cmd` in the search bar. Alternatively, press the Windows+R button combination to reach the run prompt) and run 'ncpa.cpl'. This will open a window as shown in Figure 1:

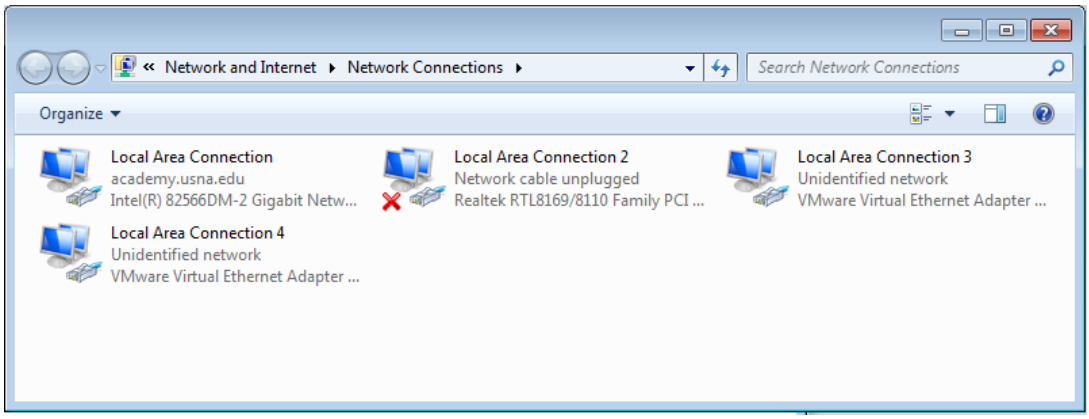


Figure 1: Network Connections

NOTE – you can get to the same window through the GUI, but it takes several steps, and is not always in the same place. For Windows 7, it can be at either: Start->Control Panel->Network and Sharing Center->Change Adapter Settings or Start->Control Panel->View network status and tasks->Change Adapter Settings.

The GUI path keeps changing, but 'ncpa.cpl' works the same for every version of Windows. I recommend that you memorize it, because you will be using this window a lot.

This will provide information about your network interface card(s). The picture above, for example, indicates the presence of four NICs, "Local Area Connection" 1 through 4. Your machine is currently connected to the `academy.usna.edu` network ("Local Area Connection"). Right-click on the "Local Area Connection" icon, and select *Properties* to get to the window shown in Figure 2.

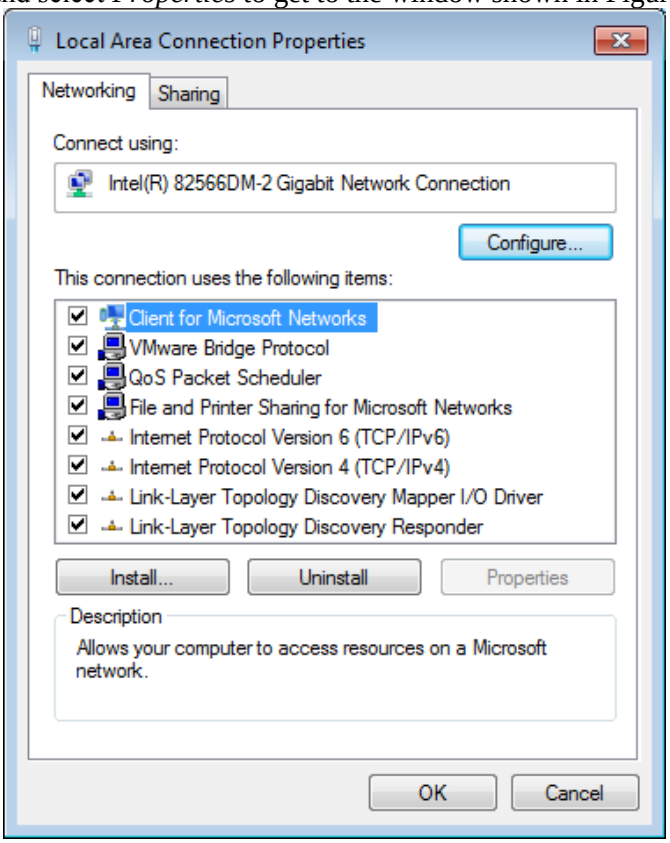


Figure 2: Connection Properties

Figure 2 tells me that my NIC is an Intel(R) 82566DM-2. Now, hover the cursor over the NIC name and your MAC address should appear.

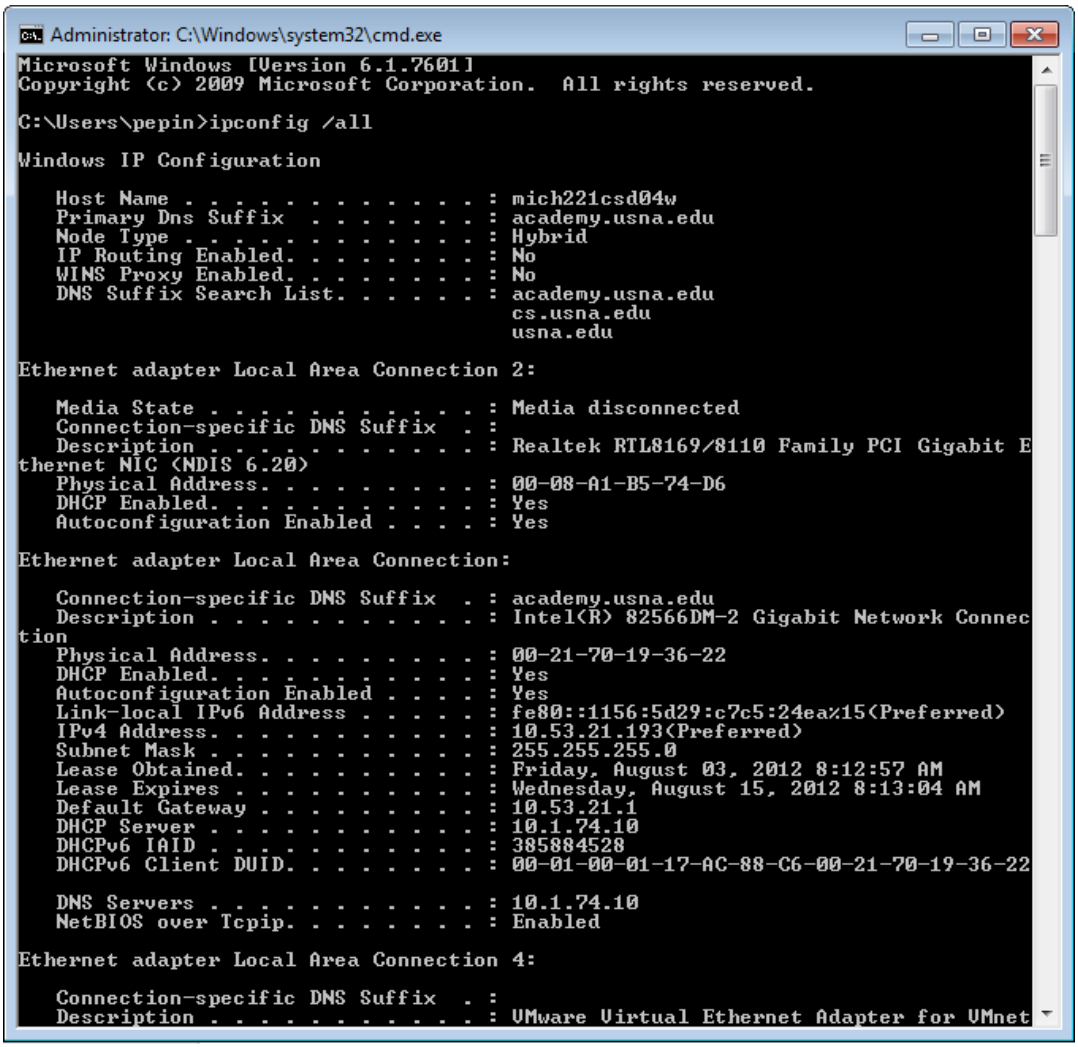
Question 1. What is your MAC address? _____

Question 2. Does anyone else in the world have this MAC address? _____

Close this window, then double-click on "Local Area Connection" to open the Status window.

Question 3. What is the speed of your network connection? _____

There is a simpler way to find out your MAC address. Open the Windows command prompt then type `ipconfig /all`. You should see results similar to Figure 3.



```
Administrator: C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation.  All rights reserved.

C:\Users\pepin>ipconfig /all

Windows IP Configuration

   Host Name . . . . . . . . . . . . : mich221csd04w
   Primary Dns Suffix  . . . . . . . : academy.usna.edu
   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No
   WINS Proxy Enabled. . . . . . . . : No
   DNS Suffix Search List. . . . . . : academy.usna.edu
                                       cs.usna.edu
                                       usna.edu

Ethernet adapter Local Area Connection 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Realtek RTL8169/8110 Family PCI Gigabit E
thernet NIC (NDIS 6.20)
   Physical Address. . . . . . . . . : 00-08-A1-B5-74-D6
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . : academy.usna.edu
   Description . . . . . . . . . . . : Intel(R) 82566DM-2 Gigabit Network Connec
tion
   Physical Address. . . . . . . . . : 00-21-70-19-36-22
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::1156:5d29:c7c5:24ea%15(Preferred)
   IPv4 Address. . . . . . . . . . . : 10.53.21.193(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Lease Obtained. . . . . . . . . . : Friday, August 03, 2012 8:12:57 AM
   Lease Expires . . . . . . . . . . : Wednesday, August 15, 2012 8:13:04 AM
   Default Gateway . . . . . . . . . : 10.53.21.1
   DHCP Server . . . . . . . . . . . : 10.1.74.10
   DHCPv6 IAID . . . . . . . . . . . : 385884528
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-17-AC-88-C6-00-21-70-19-36-22

   DNS Servers . . . . . . . . . . . : 10.1.74.10
   NetBIOS over Tcpip. . . . . . . . : Enabled

Ethernet adapter Local Area Connection 4:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : VMware Virtual Ethernet Adapter for VMnet
```

Figure 3: Result of running "ipconfig /all"

Question 4. What is your IP address? _____

A MAC address has structure, just like a Social Security number. The first three digits of your SSN give some geographic information. If you're curious, visit this site to find out more: http://www.ssa.gov/employer/stateweb.htm

The first 6 digits of your MAC address are assigned to a particular manufacturer. Visit this site and type in the first 6 digits of your MAC into the OUI search box. (OUI stands for Organizationally Unique Identifier) http://standards.ieee.org/regauth/oui/index.shtml

Question 5. Which vendor made your network card? _____

Note that various vendors provide software (or free information) that attempts to trick a network into thinking that our MAC address is different from that actually burned into our NIC. This is called MAC spoofing.

We interrupt this lab to bring you this important safety message:

Do not attempt to implement MAC spoofing on any machine connected to a USNA network! Ward Hall will find out and the ensuing carnage will be very unpleasant.

We now return to our regularly-scheduled lab.

Go to the website http://www.klcconsulting.net/smac/

Question 6. What are two legitimate (i.e., non-evil) reasons why one might want to spoof their MAC address?

_____

_____

Question 7. What is one illegitimate (i.e., evil) reason why one might want to spoof their MAC address?

_____

Part 2. Ping

`ping` is a tool that can be used to determine whether our computer can reach another computer across the Internet. From the Windows command prompt, type: `ping google.com`

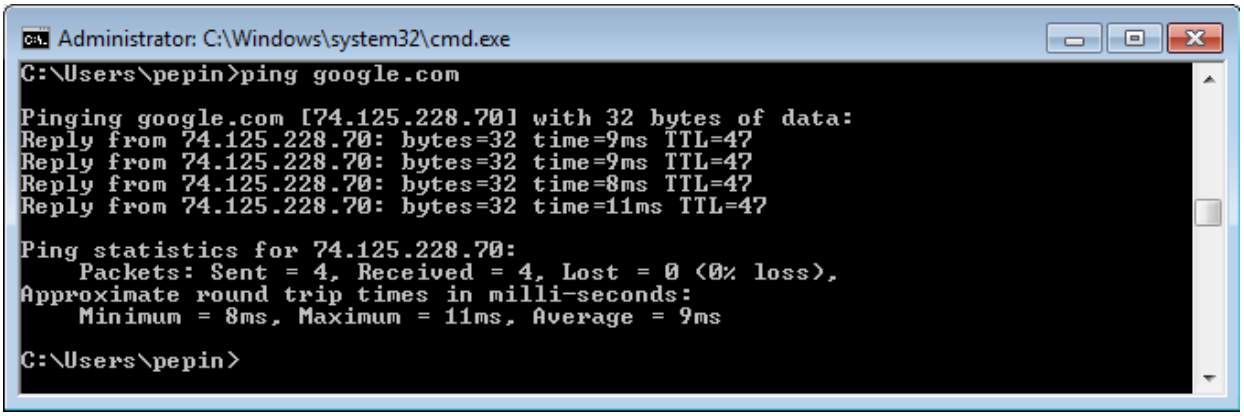


Figure 4: Result of "ping google.com"

`ping` is a probing tool that sends a packet from your computer to the designated target computer (in this case, the computer with the name `google.com`) and waits for a reply. The output in Figure 4 tells us several things:

- Our ping packet contained 32 bytes of data
- We conducted a total of 4 probes
- We received replies to all four of our probes
- The round trip time for our four probes were 9, 9, 8 and 11 milliseconds.

Looking at the `ping` reply above, notice that `google.com` is also referred to as "74.125.228.70." This latter sequence of four numbers (separated by decimals) is termed the computer's *IP address*. Thus, the computer named `google.com` has IP address 74.125.228.70. Now go type this IP address in your browser.

Question 8. To what site does it take you? _____

Question 9. Using `ping`, what is the IP address for *www.usna.edu*? _____

This semester you will learn about the different uses, assignment schemes and directories for MAC addresses, IP addresses and URLs.

Part 3. Traceroute

The Traceroute program is another useful program that gives insight into how a network is operating. Traceroute sends special packets through the network that cause all the routers to report back to the sending computer. This allows the sender to get a picture of the network between themselves and a destination.

- Visit www.traceroute.org
- Click on USA and choose the University of Southern California.
- Accept the security warning to perform a traceroute between USC and your computer.

The output from traceroute is in 6 columns. The first column is the number of the router on the path between the two computers. The second column is the name of the router. The third column is the IP address of the router. The last 3 columns are the delays encountered by the messages.

Question 10. How many routers are there between USC's computer and the first router with a 138.* IP address? _____

Question 11. What is the longest delay shown? _____

Now go back and choose *Australia* and *Telstra*. Type in your computer's IP address.

Question 12 How many routers are there between Telstra's computer and the first router with a 138.* IP address? _____

Question 13. What is the longest delay shown? _____

Question 14 Does this make sense? Why?

_____

For another view of network delays, visit http://www.internettrafficreport.com

Question 15 What types of things could cause an internet "traffic jam"? (Hint: Click on Events)

_____

Part 4. Setting up a basic network

Up to this point we had you using the already created USNA network. Now it's time to set up a network of your own!

- Disconnect the Cat-5 cable from your machine's NIC.
- Open the Network Connections window from the Control Panel.

Question 16. What is the status of "Local Area Connection" now? _____

Now, team up with the person sitting next to you.

Your team will need to collect the following supplies from your instructor:

- (1) Netgear Hub (minimum of two teams per hub)
- (1) Netgear AC-DC Adaptor
- (2) Cat-5 cables

Plug in the hub and use the Cat-5 cables to connect each machine to the hub. You should see lights come on where each cable is connected to the computer and to the hub. If you do not, you may have a bad cable and you should exchange it with the instructor.

Question 17. Now that the cables are connected, what is the status of the Local Area Connection?

_____

Right click on the Local Area Connection icon and select Properties. Select the *Internet Protocol Version 4 (TCP/IPv4)* line and select *Properties* to get to the window shown in Figure 5.

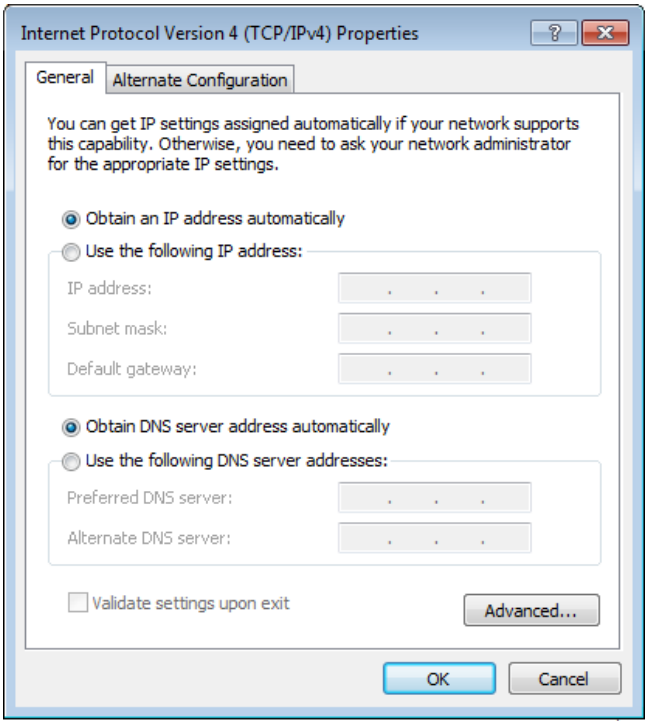


Figure 5: Internet Protocol Version 4 (TCP/IPv4) Properties

Select the radio button next to: *Use the following IP address*. Change the IP address to 10.10.10.X where X is a unique number between 1 and 254 (each computer connected to the hub must use a different number). Change the subnet mask to 255.255.255.0. Leave the Default gateway and DNS server information blank, and click *OK*.

Go to the command prompt and verify with `ipconfig /all` that your IP address changed. Now try to ping your partner's IP address. If it is not successful, you set something up wrong.

We'll learn more about the subnet mask later in the semester. Roughly, the subnet mask is used to divide the IP address into a network portion and a host portion. One useful analogy is to a street address. If you lived at 455 123rd Street the 455 would be like the host/house portion of your address and 123rd Street would be the network/street portion of your address. There's a big difference between 455 123rd Street and 4551 23rd Street. The subnet mask helps your machine know how to divide the IP address similarly.

Go to your calculator. Make sure the view is *Programmer* and convert 255 to binary.

Question 18. What is the result? _____

Every part of the subnet mask that is a 1 identifies the network part of the address. If two IP addresses have the same network address, they can talk through a simple LAN (like our setup with the hub).

Question 19. Using the mask 255.255.255.0 how many IP addresses could we have on our new Local Area Network? _

_____

Question 20. What is an example address that would not be in our Local Area Network? (Hint, try 10.10.x.x)

_____

Change one of the two machines to have this address. Try to ping each other.

Question 21. What is the result?

_____

Change the subnet masks on both machines so that this address is now part of the local network.

Question 22. What is the new subnet mask? _____

Question 23. Try to ping again. What is the result? _____

Now that you and your partner have successfully created your own network, let's see how it interacts with other computers attached to the same hub. Before you begin, set your subnet mask to 255.255.0.0, and your IP address to 10.10.X.X. Each team will use a unique number in the third octet of their IP address.

Question 24. Try to ping a machine from the other team using the same hub. What is the result?

_____

Using what you have learned so far in this lab, configure all machines connected to the hub so that any two machines attached to the same hub can ping each other.

Question 25. What did you change specifically (i.e. subnet mask, IP address, etc.) in order to enable the ability for all machines to ping one another?

_____

Part 5. Breaking out of Windows

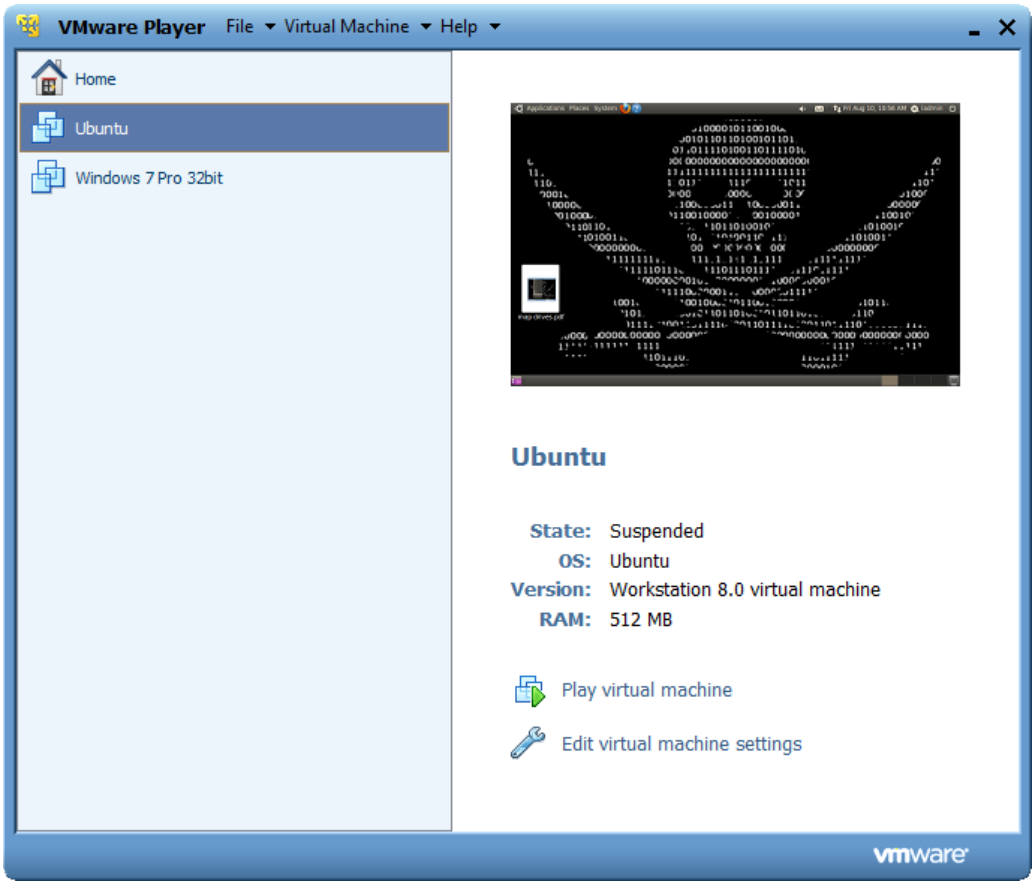
The *ping* utility uses a protocol known as Internet Control Message Protocol (ICMP) in order to test the reachability of a host and measure the round-trip time required for the exchange of messages. For more information about a protocol's specifications, the best source is a document known as a "Request for Comments" (RFC). The ICMP RFC is number 792: http://tools.ietf.org/html/rfc792.
Based on what you've learned so far, which network layer do you think the ICMP protocol is a part of?

Ping is not unique to the Windows operating system. In fact, a majority of today's servers use the Linux operating system (as well as over 90% of the top 500 supercomputers in the world). Now we'll demonstrate the ability to ping across operating systems.

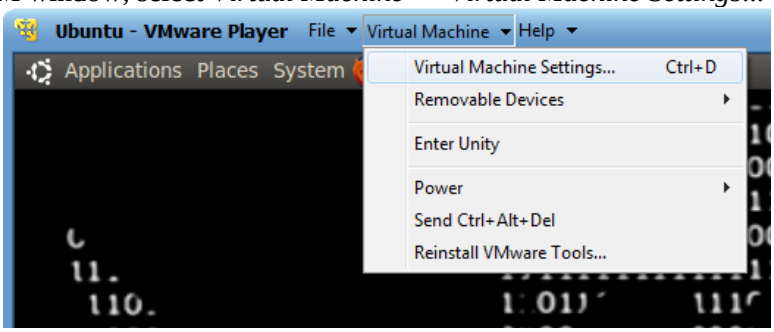
Choose one person's machine from your group and do the following:

- Start the Ubuntu Virtual Machine:
    - Double-click on the VMware Player icon on the Desktop

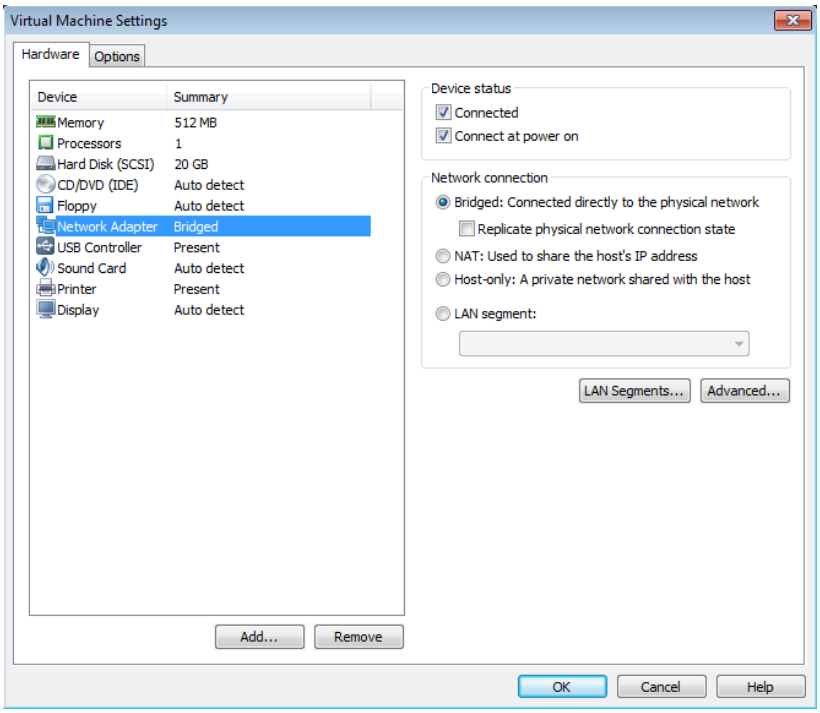
- Highlight the *Ubuntu* Virtual Machine and select *Play virtual machine*.



- Log into the VM using: user = **ladmin**, password = **l4dm1n**
- From the VM window, select *Virtual Machine -> Virtual Machine Settings*...



- Ensure that the Network connection is set to *Bridged* as shown below:



- Open a new command line terminal (Ctrl-Alt-T)
- Determine the name of the VM's network interface (most likely 'eth0'):
  - *ifconfig*
- Enter the following command, changing the interface name, IP address and subnet mask to be compatible with your network. The IP address must be unique:
  - *sudo ifconfig eth0 10.10.10.X netmask 255.255.255.0*
  - If prompted for a password, use **l4dm1n**
- Confirm network settings by using *ifconfig* again
- From the same terminal, attempt to ping one of the Windows machines connected to the hub (including the machine hosting the VM). Unlike Windows, ping on Linux requires you to specify how many attempts to make. Use the "-c 3" flag, which tells the program to stop after three attempts:
  - *ping -c 3* <IP ADDRESS>

Once the VM is configured properly, conduct the ping test again with all other machines on the hub, including the new VM.

Question 26. What is the result? _____

Close the VM and proceed.

Part 6. Cleaning it up

Great!…you just set up a very simple network. Now let's undo what you have done:

- Disconnect the Cat-5 cable, put everything back in the box, tie up the cables neatly and return all the equipment to your instructor.
- Return to the TCP/IP properties window and check the radio buttons next to: *Obtain an IP address automatically* and *Obtain DNS server address automatically*. Click *OK*.

- Plug the original Cat-5 cable (that you disconnected to begin with) back into the machine's NIC.
- Open the internet browser, go to http://www.google.com and conduct a search for your last name.

Question 27. What is the URL for the top search result? _____

Make sure you are logged off your machine. Hand in this lab assignment.