ARP Lab

For this and all labs this semester, **do not rush**. Read the lab carefully and be methodical. If there is more than one way to do something, **follow the method indicated in the lab. Repeat steps at least 3 times** before moving on. **Be sure to keep notes in your Lab Journal.**

At the end of the lab and if during the lab you need to reboot, Windows 10 shutdown doesn't really do that. You need to use **restart.**

Open a Windows's Powershell (Type *powershell* in Window's Search)

lc ***Run as adminstrator***

you can get more lines of text and a larger font size by playing with the properties after clicking the upper left hand corner icon

typing help gives a list of shell commands

run the command **ipconfig**

This will display your PC's IP address and default router (gateway) entry. The information you are looking for is for the **Ethernet adapter Ethernet** . Your IP address should be a class C address**199.17.161.xxx**. If it doesn't match this pattern, correct the entry before proceeding.

1.1 Working from Powershell. We will use two utilities to observe the ARP protocol.
PING xxx.xxx.xxx.xxx sends an ICMP echo request to the indicated node. If it is *"alive"*, it sends back an echo reply and PING displays the node's status. We will also use the **ARP** command which is described later.

In order to send an echo request to a node on the same LAN, the IP address must be bound to the physical 802.3 hardware address (MAC) (assuming you are on an "ethernet" LAN). This is done using the ARP protocol.

If the IP address is not in the local ARP Cache, the IP protocol will automatically generate an ARP request. The ARP cache can be displayed by using the ARP command. The first time you run **arp,** do not specify any options. The options will then be displayed for you.

When Pinging nodes, **`use their IP addresses`**, not their DNS names.

1.2. Run the **arp -a** command on your PC and observe the ARP cache. (We are interested in interface 4)

Flush the ARP cache **arp -d ***

If at some point, you want to repeat a step, the ARP cache can be cleared by using the *delete* option. You may either delete a single entry or the entire cache.

1.3. Ping 199.17.161.32

Examine then **flush** the ARP cache

1.4. **Before** each following Ping, **examine** then **flush** the ARP cache

Ping	199.17.161.24	Route
	199.17.166.186	Route
	199.17.162.20	Direct

RPi

.5. If possible, determine the vendor of the ethernet cards you just pinged.

Part 2

We will now change your PCs to have class C addresses with a netid of 199.17.**162**.0 and a subnet ma of 255.255.255.0

Change your PC's IP configuration by using the instructions on the Preliminary Config handout..

Set IP address to 199.17.162.**XXX**

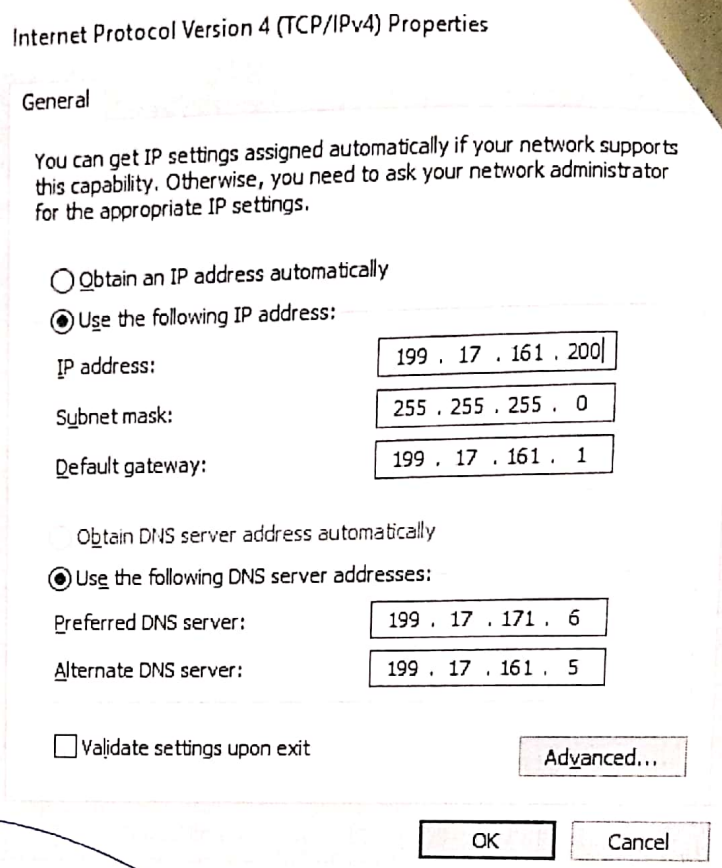
subnet mask to 255.255.255.0

Default Gateway to199.17.162.1

Mark *Use the following DNS ...*
set DNS server address to 199.17.166.186

LC on *OK*
LC on *Close*
LC on *Close*

Rerun **ipconfig** to verify the changes.



2.1. **Examine** then **flush** the ARP cache before each ping which follows.

Ping 199.17.161.32
199.17.166.186 →
199.17.161.24
199.17.162.20 →

2.2. Can you determine the vendor of the various adaptor cards that were represented in the ARP cache during step 2.1?

2.3. Ping a node that does not exist 199.17.161.2 What happens? host unreachable

2.4. Ping a node on a different site's , i.e., not WSU's network. 8.8.8.8 (google public dns) What is in the ARP cache? Ping a second node on a different network. 176.32.98.166 (Amazon) What is in the ARP cache?

2.5. Run the command **netstat -r** this will show your PC's routing table. The entry for 0.0.0.0 is for the default router.

The entries which start with 192 deal with routing to the VMware virtual machines which are treated as connected via a bridge (layer 2 device).

2.6. Flush the ARP cache.
Ping 199.17.161.32
Display the ARP cache

We will now add a **host specific route** to 199.17.161.32

Run the command
route add 199.17.161.32 199.17.162.xxx

(This means use your own ethernet interface to reach ***host*** *199.17.161.32, even though it has a different class C address)* Fill in for **xxx**, the appropriate value for your PC.

isplay the routing table to be sure the entry was accepted. **netstat -r**

Flush the ARP cache

Ping 199.17.161.32

Display the ARP cache.

Ping 199.17.161.24

Display the ARP cache

Add a **net specific route** to the 199.17.161.0 class C network

route add 199.17.161.0 mask 255.255.255.0 199.17.162.xxx

(This means use your own ethernet interface to reach ***net*** *199.17.161.0, even though it has a different class C address, note 199.17.161.0 is the address of the* ***net, not a host)***

Run **netstat -r**

Flush the ARP cache and ping 199.17.161.24 again.

What is in the ARP cache now?

Why are the ARP cache entries different then before the net specific route was added?

Remove the routing table entries you added. Use Route -h to get instructions on how.

3.1 Go back to the Ethernet 4 Properties gui and check IPv6
click ok and click close

IPv6 self configures. It will first configure a link local address by itself. This uses its mac address as part of the 128 bit IPv6 address.

It will then listen for or solicit an IPv6 ICMP router advertisement message. Using this message it will configure a publically routable IPv6 address. On our campus, it takes the first 64 bits of the router's address and appends additional bits based on its mac address.

Run the command

ipconfig

You will now see several IPv6 addresses as well as the IPv4 addresses.

The addresses which start **fe80::** are **link local addresses.**

The addresses which start **2607:** are from our **publically routable** IPv6 address block.

The command

netsh interface ipv6 show interface

presents information on IPv6's logical interfaces. Note the index number for each logical interface. You are interested in the interface *Ethernet*

Like IPv4, IPv6 must map an IP address to a mac address to send a frame over an 802.3 network. Instead of an arp cache, IPv6 maintains what it calls a neighbor cache. It uses *neighbor solicitation* messages as well as just listening to the network to build this cache.

netsh interface ipv6 show neighbor displays this cache.

Notice in this cache is an entry for the default router identified by the router's link local address. To reach a node using a link local address you must be on the same physical segment as that node. Your default router needs to be on a shared physical segment.

Using the command **ping** ***address***

Send an ICMP echo request message to another group's PC using both one of their publically routeable IPv6 addresses and one of their link local addresses. To ping the link local address you need to append **%7** to the end of the address. This tells IPv6 to use **logical interface 7** to try to find the link with the node on it.

If these addresses were not previously in your neighbor cache they should now be there.

Try these commands.

netsh interface ipv6 show addresses

netsh interface ipv6 show neighbor ~~route~~

A new version of Powershell commands uses **Get-NetRoute** instead of the previous netsh...

To see these new commands type **Get-Command -Module NetTcpip**

note for the address that starts **2607** the PrefixLength. This is used as part of IPv6's auto configuration Routers ***"advertise"*** their presence with their prefix
A node uses that to both know where the default router is and also how the node should construct its own IPv6 address.

4.1 Start your PI.

Open a terminal

Raise the authority your term is running under

sudo -i
<password>

To get help with various Linux commands use the man command.

man ***command***

When it asks *more?*, use the space bar to advance the output.

q exits the man command

note: **Unix commands are** ***case sensitive.***

splay your current configuration with the command

ifconfig

This will display among other information, your IP address.

Remember your IP address, you will need it later. 199.17.162.84

Run the command **arp**

Linux sometimes gives you a DNS name instead of the IP address in the arp cache

Run the command **man arp**

Linux's arp makes it more difficult to flush the cache. You must flush it an entry at a time.

arp -d -i eth0 address

The entry for 199.17.162.1 may stay in the cache, even if you try to remove it. Other IP addresses may stay in the table, but note that the hardware addresses associated with them will be removed.

Rerun step 1.4

You will have to use **CTRL C** to stop the Ping command, it will not stop by its self the way Windows does.

4.2 Flush both the arp cache of your PI and your Windows PC.

Ping the IP address of your Windows PC, i.e., the address you configured back in step 2.

Examine both arp caches.

Flush both caches and do the reverse, i.e., ping from Windows to Linux.

4.3 Reset your Windows IP address back to the 199.17.161.xxx class C address.

Repeat step 4.2.

Run **netstat -r** and compare what you get here to what you got under windows

- RPi
  no loopback
  no multicast

You can examine IPv6 in Ubuntu with the following:

ip -6 addr show

show interfaces and their IPv6 addresses

ip -6 route show

show the IPv6 routing table

ip -6 neigh show

show the neighbor cache

You can send an IPv6 ICMP echo request with the command

ping x.y.z.w

Examine your neighbor cache then run the command **ping 2607:f930:1100:2::32** and then examine your neighbor cache again.

2 reachable 2607 addresses

To ping a link local address in Linux use the command

ping -I eth0 fe80:xxxxxxxxx Where *eth0* is the interface to the link of interest. ✓

5.1. Write group Lab reports. Answer the questions in the procedures and discuss and explain in general what you observed and learned. Why did you see the particular addresses that were found in the ARP caches? All of the nodes in this lab are attached to a layer 2 switch. 1 node per port on the switch. Why do you see the MAC addresses of the end nodes, and not the MAC address of the switch?

Lab Report Format:

1. Title, Team Members
2. Purpose
3. Equipment/Supplies Used
4. Methodology ——— Answers to questions
5. Raw results (data)
6. Analysis of results – When did you get what behavior? Different responses, why?
7. Lessons Learned and Other Observations

Week from today (12th)