

VANIER COLLEGE – Computer Engineering Technology – Winter 2021

**Networking 1 (247-409-VA)**

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# **LABORATORY EXPERIMENT 8**

## **Internet Protocol**

**NOTE:**

To be completed in one lab session of 3 hrs.

To be submitted by the end of the lab in a zip file that also includes the PT file.

## OBJECTIVES:

After performing this experiment, the student will be able to:

1. Understand the configuration and operation of DHCP
2. Determine network information for a given IP address and network mask.

## BACKGROUND

### IP subnetting

When given an IP address and network mask, you will be able to determine other information about the IP address such as:

- Network address
- Network broadcast address
- Total number of host bits

*Task 1: For a given IP address, Determine Network Information.*

Given:

Host IP Address	172.25.114.250
Network Mask	255.255.0.0 (/16)

Find:

Network Address  
Network Broadcast Address  
Total Number of Host Bits  
Number of Hosts

Step 1: Translate Host IP address and network mask into binary notation.

Convert the host IP address and network mask to binary:

	172	25	114	250
<b>IP Address</b>	10101100	00011001	01110010	11111010
<b>Network Mask</b>	11111111	11111111	00000000	00000000
	255	255	0	0

Step 2: Determine the network address.

- Perform a bit-wise AND operation on the IP address and subnet mask.
- Express the result in dotted decimal notation.
- The result is the network address for this host IP address, which is **172.25.0.0**.

	172	25	114	250
<b>IP Address</b>	10101100	00011001	01110010	11111010
<b>Subnet Mask</b>	11111111	11111111	00000000	00000000
<b>Network Address</b>	10101100	00011001	00000000	00000000
	172	25	0	0

Step 3: Determine the broadcast address for the network address.

The network mask separates the network portion of the address from the host portion. The network address has all 0s in the host portion of the address and the broadcast address has all 1s in the host portion of the address.

	172	25	0	0
<b>Network Add.</b>	10101100	00011001	00000000	00000000
<b>Mask</b>	11111111	11111111	00000000	00000000
<b>Broadcast.</b>	10101100	00011001	11111111	11111111
	172	25	255	255

By counting the number of host bits, we can determine the total number of usable hosts for this network.

Host bits: 16

Total number of:

Addresses in network:  $2^{16} = 65,536$

Number on assignable host addresses:  $65,536 - 2 = 65,534$  (addresses that cannot be used are the all 0s address, network address, or the all 1s address, broadcast address.)

## PROCEDURE

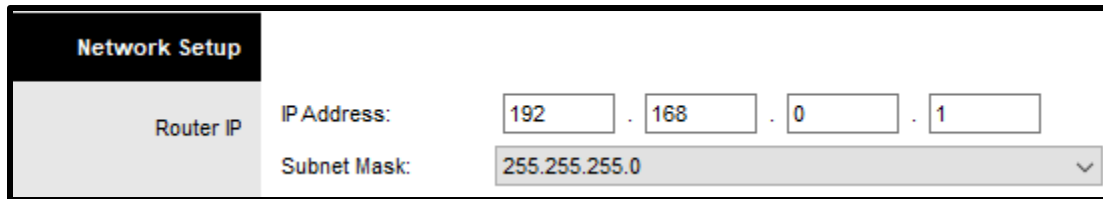
### Part A: Packet tracer challenge – Configuring DHCP on a multi-function device

*A home user wants to use a Linksys-WRT300N device to connect three PCs. All three PCs should obtain an IP address automatically from the Linksys device.*

- Create a new file in Cisco packet tracer. Set up the network topology:
  - Add three PCs to the work area.
  - Add a Linksys-WRT300N (under wireless devices) to the work area.
  - Connect each PC to an Ethernet port on the Linksys device using a straight through cable.
  - Wait until all connections are green (can take a few min).
- Observe the default DHCP settings:
  - Click on the Linksys-WRT300N Router to open the configuration window.
  - Click the **Config** tab and change the **Display Name** to *DHCP Enabled Router*.
  - Select the GUI tab. This navigates to the **Setup** page within the Linksys GUI.
  - Scroll through the Setup page to view default settings. Annotate related screen shot(s) for the answer to the following questions:

i. What is the default IP address and subnet mask?

- The default IP address and subnet mask are 192.168.0.1 and 255.255.255.0 /24. See screenshot below.



Network Setup	
Router IP	IP Address: 192 . 168 . 0 . 1
	Subnet Mask: 255.255.255.0

*Default IP address and subnet mask for the Linksys-WRT300N router shown above.*

ii. Is DHCP enabled? If yes, what is the range of the IP address pool, and what is the maximum number of users? What is the default lease time?

- The DHCP service is enabled on the Linksys-WRT300N router. The range of the IP address pool is from 192.168.0.100 – 192.168.0.149 . The maximum number of users that can receive a DHCP address from the router is 50. The default lease time is set to one whole day. See screenshot below.



DHCP Server Settings	DHCP Server:	DHCP Reservation	
	<input checked="" type="radio"/> Enabled <input type="radio"/> Disabled		
	Start IP Address: 192.168.0. 100		
	Maximum number of Users: 50		
	IP Address Range: 192.168.0. 100 - 149		
	Client Lease Time: 0	minutes (0 means one day)	

*DHCP related parameters found on the Linksys-WRT300N router shown above.*

3. Change the default IP address of the Linksys device:

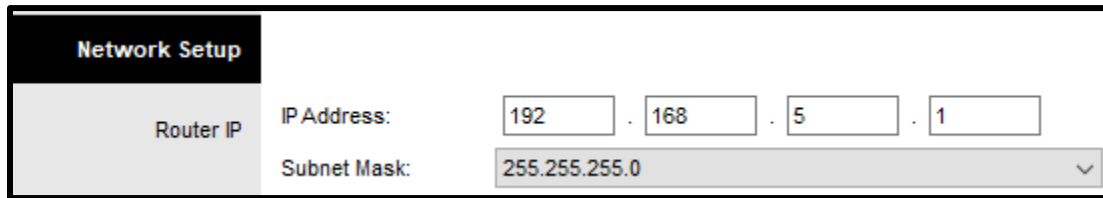
- Within the **Router IP** section, change the IP address of the Linksys device to **192.168.5.1**
- Scroll to the bottom of the GUI page and click **Save Settings**.

4. Change the default DHCP range of addresses:

- Notice the starting IP address in the DHCP Server Setting is updated to match the same network as the new IP address of the Linksys device. Change the **Starting IP Address** to **192.168.5.100**
- Change the Maximum Number of Users to 75.

c. Click Save Settings. Now what is the new IP address range?

- The new IP address range is from 192.168.5.100 to 192.168.5.174 . See screenshot below.



The screenshot shows the 'Network Setup' tab selected. Under the 'Router IP' section, the 'IP Address' is configured as 192.168.5.1 (each octet in its own box) and the 'Subnet Mask' is 255.255.255.0 (in a single box with a dropdown arrow).

*New IP settings set on Linksys WRT-300N router shown above.*

d. Close the Linksys configuration window.

5. Configure DHCP on the client workstations:

a. Enable DHCP on PC0.

- Select PC0. Click the **Config** tab. Go to the Interface **FastEthernet** sub-menu.
- Enable DHCP by selecting the DHCP button in the IP Configuration panel. What is the newly assigned IP address and subnet mask for PC0?

➤ The newly assigned IP address to PC0 is 192.168.5.103 (there are other devices connected as well so that is why it is not 192.168.5.100).
- Close the configuration window.

- b. Observe the IP configuration of a client that does not have DHCP enabled. Select PC1. Run `ipconfig` at the command prompt. Record and explain your result obtained.

```
C:\>ipconfig /all

FastEthernet0 Connection:(default port)

    Connection-specific DNS Suffix...:
    Physical Address.....: 0001.C946.DA20
    Link-local IPv6 Address.....: FE80::201:C9FF:FE46:DA20
    IPv6 Address.....: ::
    IPv4 Address.....: 0.0.0.0
    Subnet Mask.....: 0.0.0.0
    Default Gateway.....: ::
                           0.0.0.0
    DHCP Servers.....: 192.168.5.1
    DHCPv6 IAID.....:
    DHCPv6 Client DUID.....: 00-01-00-01-B9-B8-00-92-00-01-C9-46-DA-20
    DNS Servers.....: ::
                           0.0.0.0

Bluetooth Connection:

    Connection-specific DNS Suffix...:
    Physical Address.....: 0060.47C5.73DB
    Link-local IPv6 Address.....: ::
    IPv6 Address.....: ::
    IPv4 Address.....: 0.0.0.0
    Subnet Mask.....: 0.0.0.0
    Default Gateway.....: ::
                           0.0.0.0
    DHCP Servers.....: 0.0.0.0
    DHCPv6 IAID.....:
    DHCPv6 Client DUID.....: 00-01-00-01-B9-B8-00-92-00-01-C9-46-DA-20
    DNS Servers.....: ::
                           0.0.0.0
```

*IP configuration of a client (PC1) that does not have DHCP enabled (static is selected but no address is specified). The result above shows that there is no IP address assigned to the computer and default values are used instead (in this 0.0.0.0 for PT).*

- c. Enable DHCP on PC0 and PC1, using the **Config** tab as outlined in Step 5a. What are the new IP addresses and subnet mask for these clients?

```
C:\>ipconfig /all

FastEthernet0 Connection:(default port)

    Connection-specific DNS Suffix...: 
    Physical Address.....: 0001.C946.DA20
    Link-local IPv6 Address.....: FE80::201:C9FF:FE46:DA20
    IPv6 Address.....: ::
    IPv4 Address.....: 192.168.5.102
    Subnet Mask.....: 255.255.255.0
    Default Gateway.....: ::
                                192.168.5.1
    DHCP Servers.....: 192.168.5.1
    DHCPv6 IAID.....: 
    DHCPv6 Client DUID.....: 00-01-00-01-B9-B8-00-92-00-01-C9-46-DA-20
    DNS Servers.....: ::
                                0.0.0.0

Bluetooth Connection:

    Connection-specific DNS Suffix...: 
    Physical Address.....: 0060.47C5.73DB
    Link-local IPv6 Address.....: ::
    IPv6 Address.....: ::
    IPv4 Address.....: 0.0.0.0
    Subnet Mask.....: 0.0.0.0
    Default Gateway.....: ::
                                0.0.0.0
    DHCP Servers.....: 0.0.0.0
    DHCPv6 IAID.....: 
    DHCPv6 Client DUID.....: 00-01-00-01-B9-B8-00-92-00-01-C9-46-DA-20
    DNS Servers.....: ::
                                0.0.0.0
```

*Result of enabling DHCP on PC1 shown above. The new IP address for this client is 192.168.5.102 and the subnet mask is 255.255.255.0 . The reason this computer is getting an IP address is because DHCP is selected to handle IP addressing for the computer; therefore there will be no more empty default IP addresses. This is shown in the screenshot on the next page as well.*

```
C:\>ipconfig /all

FastEthernet0 Connection: (default port)

    Connection-specific DNS Suffix...:
    Physical Address.....: 0010.1164.6077
    Link-local IPv6 Address.....: FE80::210:11FF:FE64:6077
    IPv6 Address.....: ::
    IPv4 Address.....: 192.168.5.103
    Subnet Mask.....: 255.255.255.0
    Default Gateway.....: ::
                        192.168.5.1
    DHCP Servers.....: 192.168.5.1
    DHCPv6 IAID.....:
    DHCPv6 Client DUID.....: 00-01-00-01-C0-A0-CB-A4-00-10-11-64-60-77
    DNS Servers.....: ::
                        0.0.0.0

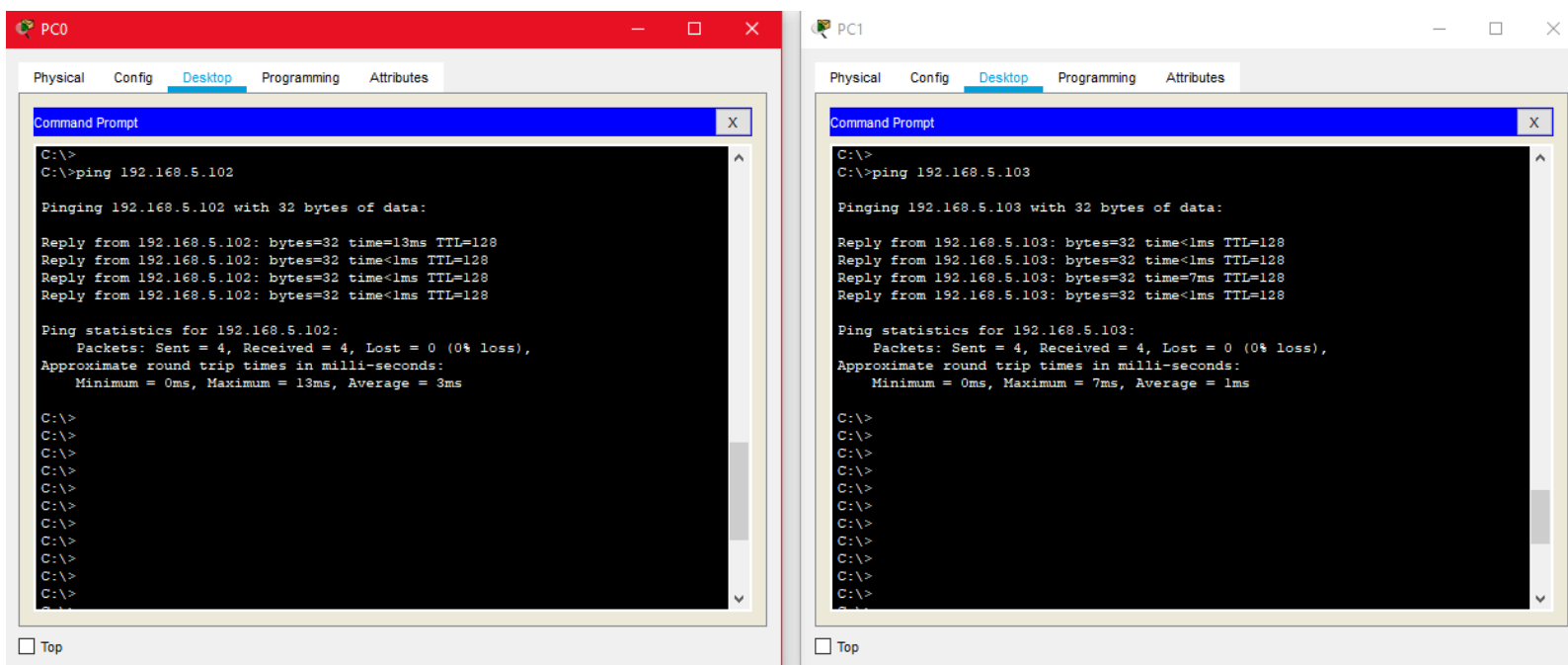
Bluetooth Connection:

    Connection-specific DNS Suffix...:
    Physical Address.....: 0000.0C40.31CE
    Link-local IPv6 Address.....: ::
    IPv6 Address.....: ::
    IPv4 Address.....: 0.0.0.0
    Subnet Mask.....: 0.0.0.0
    Default Gateway.....: ::
                        0.0.0.0
    DHCP Servers.....: 0.0.0.0
    DHCPv6 IAID.....:
    DHCPv6 Client DUID.....: 00-01-00-01-C0-A0-CB-A4-00-10-11-64-60-77
    DNS Servers.....: ::
                        0.0.0.0
```

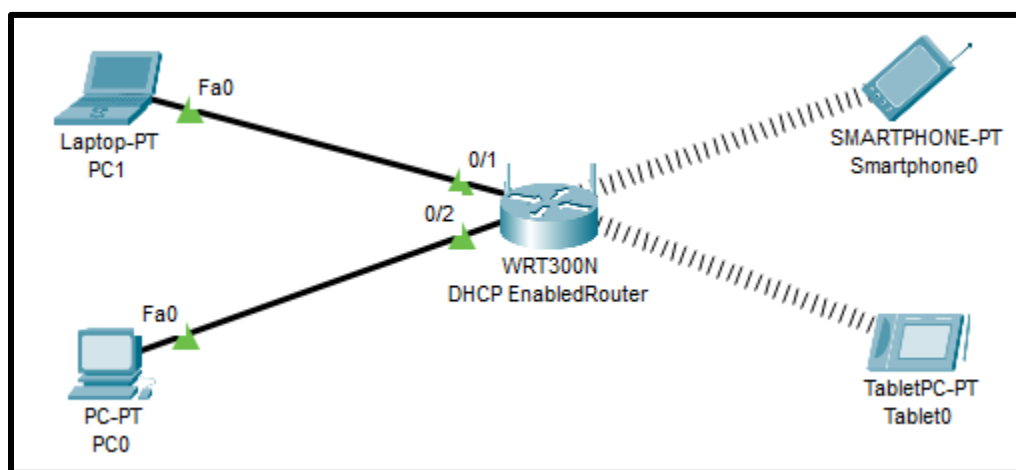
*Result of enabling DHCP on PC0 shown above. The new IP address for this client is 192.168.5.103 and the subnet mask is 255.255.255.0 . Reason why this is occurring can be found under the screenshot on the previous page.*



6. Verify connectivity by pinging between the workstations. Demo to teacher.



Basic connectivity test between the two computers (PC0 and PC1) done using ping command from each computer. PC0 (192.168.5.103) can ping PC1 (192.168.5.102) and vice versa successfully. Network diagram can be found below.



Basic network created in PT shown above. There are a total of 4 devices connected to the Linksys WRT-300N both physically and wirelessly. PC0 and PC1 are connected physically using a copper straight-through cable and the tablet and smartphone are connected wirelessly via the "Lab8" SSID (the password is !Lab8100) and can be seen by the dashed lines above.

## Part B: IP subnetting challenge

**\*\* For all the problems below, create a subnetting worksheet to show and record all work for each problem. Ensure that you are familiar in using your calculator to perform all numeric conversion among decimal, binary and hexadecimal.**

### 7. Problem 1:

Host IP Address	172.30.1.33
Network Mask	255.255.0.0
Network Address	-> 1111 1111.1111 1111.0000 0000 0000 0000 AND -> 1010 1100.0001 1110.0000 0001.0010 0001  = 1010 1100.0001 1110.0000 0000.0000 0000 = 172.30.0.0
Network Broadcast Address	-> 1010 1100.0001 1110.1111 1111.1111 1111  = 172.30.255.255
Total Number of Host Bits	16 bits
Number of Hosts (not assignable)	65'536 ( $2^{16}$ )

### 8. Problem 2:

Host IP Address	172.30.1.33
Network Mask	255.255.255.0
Network Address	-> 1111 1111.1111 1111.1111 1111.0000 0000 AND -> 1010 1100.0001 1110.0000 0001.0010 0001  = 1010 1100.0001 1110.0000 0001.0000 0000 = 172.30.1.0
Network Broadcast Address	-> 1010 1100.0001 1110.0000 0001.1111 1111  = 172.30.1.255
Total Number of Host Bits	8 bits
Number of Hosts (not assignable)	256 ( $2^8$ )

### 9. Problem 3:

Host IP Address	192.168.10.234/23
Network Mask	1111 1111.1111 1111.1111 1110.0000 0000  = 255.255.254.0
Network Address	-> 1111 1111.1111 1111.1111 1110.0000 0000 AND -> 1100 0000.1010 1000.0000 1010.1110 1010  = 1100 0000.1010 1000.0000 1010.0000 0000 = 192.168.10.0
Network Broadcast Address	-> 1100 0000.1010 1000.0000 1011.1111 1111  = 192.168.11.255
Total Number of Host Bits	9 bits
Number of Hosts (not assignable)	512 ( $2^9$ )

## 10. Problem 4:

Host IP Address	172.17.99.71/21
Network Mask	1111 1111.1111 1111.1111 1000.0000 0000 = 255.255.248.0
Network Address	-> 1111 1111.1111 1111.1111 1000.0000 0000 AND -> 1010 1100.0001 0001.0110 0011.0100 0111 = 1010 1100.0001 0001.0110 0000.0000 0000 = 172.17.96.0
Network Broadcast Address	-> 1010 1100.0001 0001.0110 0111.1111 1111 = 172.17.103.255
Total Number of Host Bits	11 bits
Number of Hosts (not assignable)	2 <sup>10</sup> 48 (2 <sup>11</sup> )

## 11. Problem 5:

Host IP Address	192.168.3.219/26
Network Mask	1111 1111.1111 1111.1111 1111.1100 0000 = 255.255.255.192
Network Address	-> 1111 1111.1111 1111.1111 1111.1100 0000 AND -> 1100 0000.1010 1000.0000 0011.1101 1011 = 1100 0000.1010 1000.0000 0011.1100 0000 = 192.168.3.192
Network Broadcast Address	-> 1100 0000.1010 1000.0000 0011.1111 1111 = 192.168.3.255
Total Number of Host Bits	6 bits
Number of Hosts (not assignable)	64 (2 <sup>6</sup> )

## 12. Problem 6:

Host IP Address	192.168.3.218
Network Mask	255.255.255.252
Network Address	-> 1111 1111.1111 1111.1111 1111.1111 1100 AND -> 1100 0000.1010 1000.0000 0011.1101 1010 = 1100 0000.1010 1000.0000 0011.1101 1000 = 192.168.3.216
Network Broadcast Address	-> 1100 0000.1010 1000.0000 0011.1101 1011 = 192.168.3.219
Total Number of Host Bits	2 bits
Number of Hosts (not assignable)	4 (2 <sup>2</sup> )