LABORATORY 2: SUBNET MASK

Objectives

By the end of the laboratory, students will be able to

- set up a computer network with correct subnet mask.
- design a suitable subnet mask.

Introduction:

IP addresses have two portions: Network portion and Host portion. End devices in the same network would have identical Network portion but different Host portion. End devices with different Network portions belong to different network, and they cannot communicate with one another without the help of routers.

The Network portion and Host portion of an IP address are defined by subnet mask used. Subnet masks are 32-bit binary number with string of '1's defines the Network portion, and string of '0's indicates the Host portion. Just like IP addresses, subnet masks are generally presented in dotted decimal format for ease of reading. Using correct subnet mask for end devices is important, else the end devise may be blocked from communicating with other end devices.

Classes A, B and C IP addresses use default subnet masks with number of bits in their Network portion that is multiple of 8. This results in inflexibility and waste of Class A IP addresses. The Classless Inter-Domain Routing (CIDR) allows IP addresses with any address bit boundary, instead of on 8-bit blocks. The prefix length, a slash followed by an integer, is used to indicate the actual number of bits in the Network portion.

Equipment:

Windows OS laptops with Cisco Packet Tracer installed.

Procedures:

1. Construction and Configuration of Computer Networks for Testing Subnet Masks

1.1 Construct the network shown in Figure 2.1.

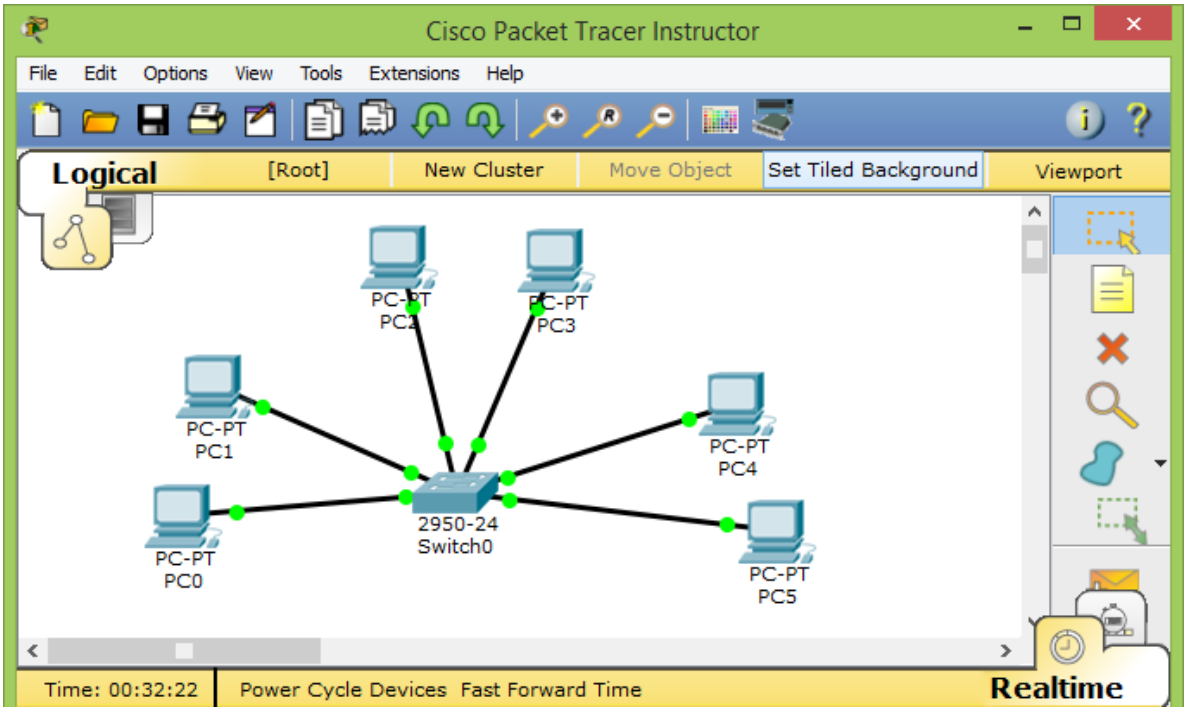

Figure 2.1 - A network for testing subnet masks.

1.2 Configure the six computers with parameters as shown in Table 2.1 below. Take note of the differences among the computers in the **second** and/or **third bytes** of their IP address.

Computer	IP Address	Subnet Mask
PC0	192.168.1.100	255.255.255.0
PC1	192.168.1.101	255.255.255.0
PC2	192.168.2.102	255.255.255.0
PC3	192.168.2.103	255.255.255.0
PC4	192.200.3.104	255.255.255.0
PC5	192.200.3.105	255.255.255.0

Table 2.1 – Network configuration parameters for Figure 2.1.

Question:

The subnet mask used is 255.255.255.0. What is the number of bits in the Network portion of these IP addresses?

There are 24 bits in the network portion.

1.3 Test the connectivity between the pairs of computers listed in Table 2.2 using the "ping" utility. Record your results into the table. Although the computers are all physically connected to the switch, you will observe that some connectivity test fail.

Subnet mask = 255.255.255.0		
Computer 1	**Computer 2**	**"Ping" successful?**
PC0	PC1	Yes / No
PC0	PC2	Yes / No
PC0	PC4	Yes / No
PC1	PC2	Yes / No
PC1	PC0	Yes / No
PC1	PC4	Yes / No
PC4	PC0	Yes / No
PC4	PC2	Yes / No
PC4	PC5	Yes / No

Table 2.2 – Connectivity tests to be conducted.

Question:

Study your connectivity test results carefully. What conclusion can you draw about the relationship between IP addresses (particularly, the first three bytes of the IP addresses) and the connectivity test outcome?

The outcome is contingent upon the IP address having the same first 3 bytes of the IP address.

1.4 Change the subnet mask of all computers from 255.255.255.0 to 255.255.0.0 and carry out connectivity tests as shown in Table 2.3.

Subnet mask = 255.255.0.0		
Computer 1	**Computer 2**	**"Ping" successful?**
PC0	PC1	Yes / No
PC0	PC2	Yes / No
PC0	PC4	Yes / No
PC1	PC2	Yes / No
PC1	PC0	Yes / No
PC1	PC4	Yes / No
PC4	PC0	Yes / No
PC4	PC2	Yes / No
PC4	PC5	Yes / No

Table 2.3 – Connectivity tests to be conducted.

Question:

Any change in the connectivity test outcome between PC0 and PC2? Can you explain why?

PC0 can now ping PC2 and PC1 can ping PC2. The subnet mask was changed from 255.255.255.0 to 255.255.0.0. This allows the 3rd byte to act as a host portion of the IP address instead of a network portion.

1.5 Change the subnet mask of all computers to 255.0.0.0 and re-do the connectivity tests.

Question:

Can all the computers ping one another?

Yes.

Question:

With subnet mask of 255.0.0.0, how many bits of the Network portion of these computers' IP addresses must be identical?

8 bits of the IP address must be identical

1.6 Change the IP address of PC5 to 200.200.3.105. Try pinging PC5 from PC0 again (or any other computers).

Question:

Is the connectivity test successful?

The connectivity test failed.

Question:

Suggest a new subnet mask to make pinging between PC0 and PC5 possible. Write it down using the space provided below. Show all the steps how you derive this new subnet mask using the empty space provided on next page.

New subnet mask	240.0.0.0

Show your working here:
For PC0, it's first byte, decimal:192 is equal to binary:1100 0000. For PC5, it's first byte, decimal:200 is equal to binary:1100 1000. By setting the first byte of the subnet to 240, which is equal to binary:1111 0000, we are setting the system to only utilise the first 4 bits of each number to act as the networking portion. This causes them to have the same networking portion, allowing them to ping each other.

1.7 Test your new subnet mask by pinging PC5 from PC0.

Question:

Is the connectivity test successful?

The test was succesfull.

Question:

If the IP address of PC5 is changed to 60.200.3.105, do you think you can design a subnet mask to allow pinging between PC0 and PC5? Why?

No. Decimal:60 equals binary:0011 1100, the smallest subnet mask available is 1000 0000, which equals 128 as subnet mask must start with a '1'. Hence I cannot design a subnet mask that allows pinging between PC0 and PC5.