TNE20003 – Internet and Cybersecurity for Engineering Applications

Portfolio Task – Lab 3 Distinction Task

Aims:

- To practice subnetting
- To understand how arp works
- To investigate how MAC addresses are used and how the CAM table in a switch is populated.

Preparation:

- View "Network Devices - Routers and Switches"
- Lab 2 D Task

Due Date:

- Task1 must be completed before the lab and uploaded to Canvas. Your demonstrator will check the answers to the questions and your working out for task 1 and may ask questions during the lab session. Task 2 will be assessed via an online quiz. You must score the required minimum to pass the test. You will be allowed a number of attempts to pass the test at that grade level. You are encouraged to complete the test during the lab but if you do not, you must complete it before your next lab class.

Task 1.

Practice Subnetting

In this task, you will

- Subnet the given network (n/w) in the diagram below and allocate a subnet address to each relevant segment.

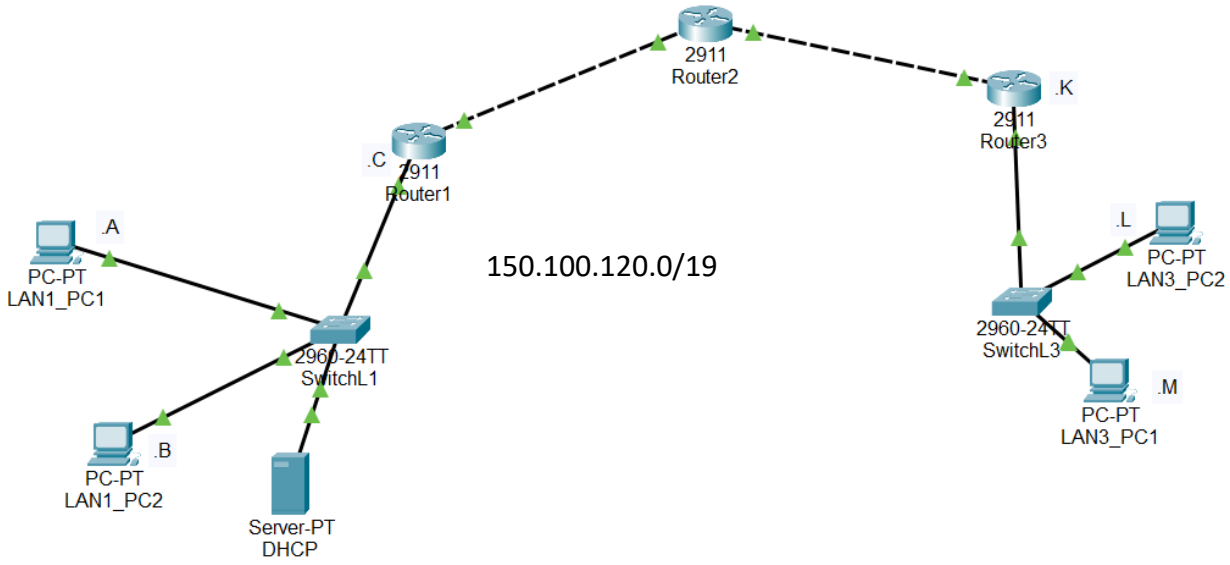


Figure 1

What is the subnetwork address of the IP given above???? 150.100.96.0 /19

How many n/ws do we need to build this n/w? 4 networks

How many bits need to be borrowed? 2 bits

What do the dotted lines connecting 2 routers mean? the cross-over connectivity between 2 routers is the point-to-point link which is also a network.

Task 2.

Build the network provided in task 1 with Cisco Packet Tracer and observe the building of ARP tables in the PCs and CAM table in the switch

1. Implement the network shown in figure 1 above.

   The bottom left hand corner of the Packet tracer screen displays the icons that represent device categories or groups, such as **Routers**, **Switches**, or **End Devices**.

   Moving the cursor over the device categories will show the name of the category in the box. To select a device, first select the device category. When the device category is selected, the options within that category appear in the box next to the category listings. Select the device option that is required.

   a. Select **End Devices** from the options in the bottom left-hand corner. Drag and drop 4 PCs and 1 Server onto your design area.

   b. Select **Switch** from the options in the bottom left-hand corner. Add 2 2960 switches to your prototype network by dragging them onto your design area.

   c. Select **Router** from the options in the bottom left-hand corner. Add 4 2911 routers to your prototype network by dragging them onto your design area

   d. Double click on each of the devices and name them as per the network diagram in figure 1.

   e. Select **Connections** from the bottom left-hand corner. Choose a copper straight-through cable type. Click the first PC (PC1) and assign the cable to the **FastEthernet0** connector. Click the switch (LS1) and select **FastEthernet0/1** to connect to PC1.

   f. Select **Connections** from the bottom left-hand corner. Choose a copper straight-through cable type. Click the second PC (PC2) and assign the cable to the **FastEthernet0** connector. Click LS1 and select **FastEthernet0/2** to connect to PC2.

   g. Select **Connections** from the bottom left-hand corner. Choose a copper straight-through cable type. Click the third PC (PC3) and assign the cable to the **FastEthernet0** connector. Click LS1 and select **FastEthernet0/3** to connect to PC3.

   h. Select **Connections** from the bottom left-hand corner. Choose a copper straight-through cable type. Click the switch (LS1) and select **FastEthernet0/4** to connect to **GigabitEthernet0/0** of Rtr1.

   i. Repeat these steps for all of the other devices until they are all connected as per the n/w diagram in figure 1. Note when connecting 2 routers together you need to use a cross-over cable because they are like devices, ie both are DTEs. Or you can use a serial cable.

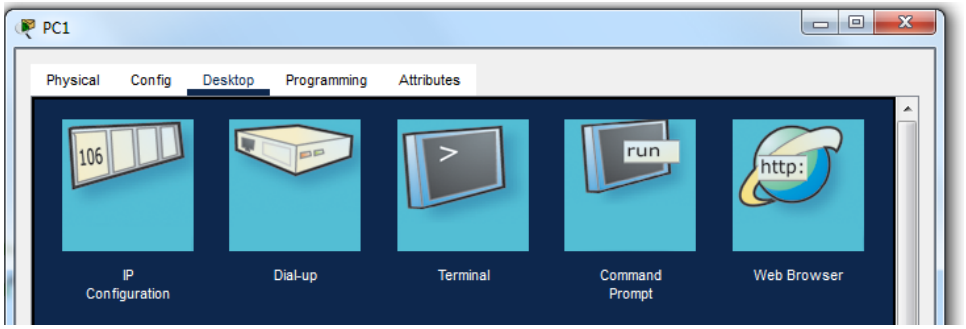
There should be green dots at both ends of each cable connection after the network has converged. If not, double check the cable type selected. Note with the routers in particular, you may need to turn that interface on by clicking the **"on"** button under the interface tab or by issuing the command **"no shut"** on the interface in the CLI mode. See below:

```
Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0
Router(config-if)#no shut
```

2. Configure Host names and IP Addresses on the PCs, the Server, the switches and the routers as per the n/w diagram in figure 1 above.

3. On each PC observe the current status of the ARP table by issuing the following command and note what is displayed.

    a. Click on the PC and choose "**desktop"** and then click on the **"command prompt"**



    b. When the **"command prompt"** window appears type **"arp -a"**

    c. Record what is displayed. No ARP Entries Found

4. On the switch LS1 issue the following commands to see what is stored in the CAM table

    a. Choose the "**CLI"** mode

    b. Click enter until you see the following prompt: Switch>

c. Type **"enable"**

d. Type **"show arp"** what do you see? See pic below for guide Nothing appears

e. You can investigate the CAM table of the switch by typing **"show mac address-table"**. what do you see? On Switch L1, there is only one mac-address of int G0/0 R1 come up. On Switch L2, there are 3 mac-addresses respectively: DHCP, PC2, PC1.

```
Switch>ena
Switch#sh arp

Switch#sh arp ?
  <cr>
Switch#sh mac ad
Switch#sh mac address-table
          Mac Address Table
-------------------------------------------

Vlan    Mac Address       Type        Ports
----    -----------       --------    -----

   1    0001.42ad.9001    DYNAMIC     Fa0/4
Switch#
```

f. Whose MAC address could this be? G0/0 R1 MAC address traverse to Port Fa0/4 on switch L1

g. Before you leave the switch type the following commands to make sure it stays in the privileged mode of operation. See pic below for commands and steps.

```
LS1>
LS1>enable
LS1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
LS1(config)#line console 0
LS1(config-line)#exec
LS1(config-line)#exec-timeout 0 0
LS1(config-line)#
```

5. If want to observe the flow of data in PT between PC1 and PC2 follow the commands below or jump to step 6.

   a. Switch to **Simulation Mode** in the bottom right-hand corner.

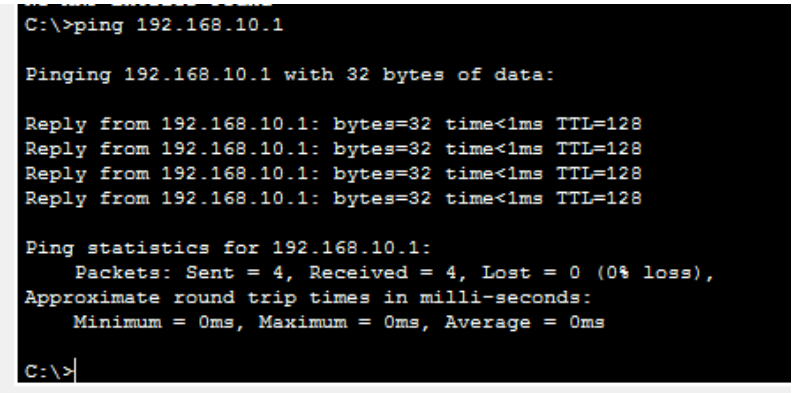
b. Click **Edit Filter** in the **Edit List Filter** area. In the event list filter, *only select* **ARP** and **ICMP** filters under IPv4 tab, deselect all other filters in the three tabs **IPV4, IPV6** and **Misc**.

c. Select a **Simple PDU** by clicking the **closed envelope** in the upper toolbar.

With the envelop icon, click **PC2** to establish the source. Click **PC1** to establish the destination.

6. Let's investigate what happens to the **ARP** tables of the PC and the **CAM** table of LS1 when we issue some more pings.

a. Click on **PC2** and from the Desktop link choose the Command Prompt and type the following command when you see the prompt C:\>**"ping (put the IP address of PC1 here)"** and you should see something similar to the pic below



b. Repeat steps 3 and 4 above to see if any of the tables have changed. An entry is added in PC1 arp table which is the address of PC2 and vice versa

c. What did you observe? Did anything change in the CAM table of LS1. Explain it in your own words.
2 new mac addresses are addes in LS1 CAM table which are PC1 and PC2 MAC addresses after the ping issue between them

d. What happens to the CAM table in LS1 if you don't do anything for a period of time (more that 5 min)?

After not doing more than 5 min, the 2 new address disappears.

7. Using the IP addresses you have configured previously, from **PC2** ping all of the other PCs including the server.

a. Click on **PC2** and from the Desktop Command Prompt type **"ping (put the IP address of PC3 here)"**. Look at the CAM table of LS1, has there been any changes.

MAC address of PC3 is added to the LS1 CAM table

b. Click on **PC2** and from the Desktop Command Prompt type **"ping (put the IP address of R1 interface connected to the switch)"**. Was the ping successful? Explain why or why not. Look at the CAM table of LS1, has there been any changes. Yes. the ping is successful. MAC address of PC2 is added to LS1 CAM table

c. Click on **PC2** and from the Desktop Command Prompt type **"ping (put the IP address of PC4 here)"** Was the ping successful? Explain why or why not. Look at the CAM table of LS1, has there been any changes. The ping will be successful if the default-gateway is configured on both PC2 and PC4 and the static route is configured on all routers.The MAC address of PC1 is not added to LS1 CAM table but the MAC address of G0/0R1

d. Click on LAN_PC2 and from the Desktop Command Prompt type **"ping (put the IP address of the Server here)"** Was the ping successful? Explain why or why not. Look at the CAM table of LS1, has there been any changes.

e. What did you observe? Explain it in your own words.

8. We need to facilitate end-to-end communication.

a. Using your prior knowledge gained from lab 2 D enter a default gateway into each of the PCs and the Server and add the relevant static routes to ensure end-to-end connectivity.

b. On LAN1_PC1 issue the command **arp -a.** What do you see? Make note of the mappings that exist.

c. Ping from LAN1_PC1 to Router 2. The ping should be successful. If not investigate and rectify the problem.

d. On LAN1_PC1 issue the command **arp -a.** What do you see? Has the MAC address of Router1 been added to your ARP table?

e. Ping from LAN1_PC1 to Router 3. The ping should be successful. If not investigate and rectify the problem.

f. On LAN1_PC1 issue the command **arp -a.** What do you see? Has the MAC address of Router2 been added to your ARP table?

g. Ping from LAN1_PC1 to LAN3_PC1. The ping should be successful. If not investigate and rectify the problem.

h. On LAN1_PC1 issue the command **arp -a.** What do you see? Has the MAC address of LAN3_PC1 been added to your ARP table?

i. What conclusion can you draw about the ARP process across different networks?

If a PC pings another PC in the same subnet, the CAM table will record the source port, destination port, source MAC address and destination MAC address. However, when a PC pings another PC in different network, the CAM table will only record the source port and source MAC address.

~~~~~ End of Lab ~~~~~

ARP process: Assume for the moment that host A wishes to speak with host B. Although host A is aware of host B's IP address, it is unaware of host B's MAC address. Host A makes an ARP request with the IP address of host B as the destination and the MAC address of FF:FF:FF:FF:FF:FF (Ethernet broadcast) in order to obtain the MAC address of host B. With the exception of the entering interface, Switch will forward the frame out all interfaces. The packet will be received by every device on the segment; however, only host B will reply with the A RP reply packet, containing its MAC address, since the target IP address is host B's IP address. With the information at hand, host A can now direct traffic to host B.