

Layered Architectures: Addressing, Encapsulation, and Layers Working Together I

Instructions:

- You are required to do each step (in part-1, part-2, and part-3) as instructed below.
 - You are advised to discuss with the Instructors if you are not clear about any issues.
 - You are required to write a report and submit within a week from your practical session. In your report, each problem/question should be addressed.
 - You are advised to **note any outputs and take trace files with you** when you leave the laboratory for later examination. These notes/files might help prepare a good report.
 - If you need laboratory computers to examine the trace files at a later time, approach the Instructors.
 - Time: 2 hours.
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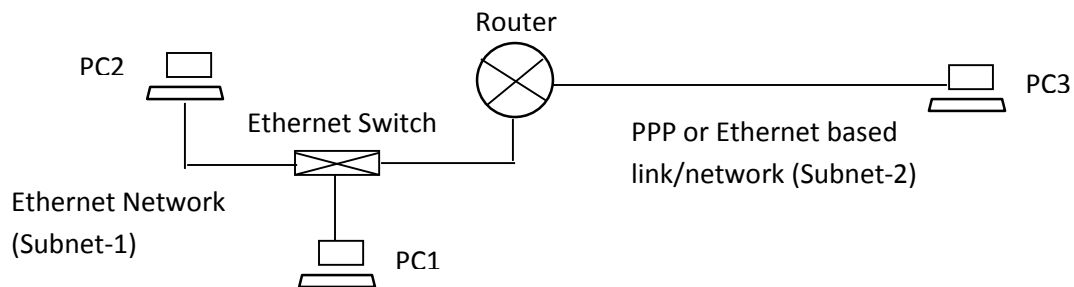


Fig. 1 Network scenario 1

Connect the devices/components to set up the network as shown in Fig. 1.

Part-1: IP addresses and MAC addresses

a. Assigning IP addresses to Interfaces

- With the help of the Instructors, decide how IP addresses can be assigned for subnet-1 and subnet-2, and the interfaces in the subnets. Based on your assignment, give addresses of the following:
 - Subnet-1:
 - Subnet-2:
 - PC1's Interface on Subnet-1:
 - PC2's Interface on Subnet-1:
 - Router's Interface on Subnet-1
 - Router's Interface on Subnet-2:
 - PC3's Interface on Subnet-2:

- In Fig.1, mark/label the interfaces (and the subnets) with the IP addresses.
- Based on your assignment above, configure PC1, PC2, and PC3 to assign IP addresses (you may refer to the Instruction-sheet)
- Configure the Router to assign IP addresses to its interfaces on subnet-1 and subnet-2. (you may refer to the Instruction-sheet)
- Check and confirm that your addresses are correctly assigned to the corresponding interfaces.

b. Finding MAC addresses

Find the MAC address of the NIC attached to each host. Find the MAC addresses associated with the Router.

- PC1:
- PC2:
- PC3:
- MAC addresses associated with the Router:
- In Fig. 1, mark the MAC addresses.

Part-2: Routing tables (IP tables)

- a. Find the Routing Table at PC1, PC2, and PC3. Describe the different rows and columns in the tables.
 1. Routing Table @ PC1:
 2. Routing Table @ PC2:
 3. Routing Table @ PC3:
- b. Find the Routing Table in the Router (you may refer to the Instruction-sheet). Describe the different rows and columns in the table.
 1. Routing Table @ Router:

Part-3: Encapsulation and the use of routing tables

Sending a packet from PC1 to PC2

- a. Use the *ping* tool to send frames from PC1 to PC2. Use the Wireshark network protocol analyzer at PC1 and PC2 to capture the frames sent and received. Save the trace-files (file names: CO223_Lab3_3a_PC1, CO223_Lab3_3a_PC2).
 1. Recall (or discuss with the Instructor) how the ping tool works ('ping' uses a protocol called the Internet Control Message Protocol (ICMP). Ping makes use of ICMP request and response messages)
 2. Analyze the trace-file (CO223_Lab3_3a_PC1) and identify the frames associated with your ping command. (To filter out other unrelated frames, you may use *filter* in the Wireshark).
 3. Select a frame which is sent from PC1 to PC2 as a result of the ping command. Give the frame no. in your trace. (In your report, attach a screenshot of the Wireshark panes with the selected frame)
- b. From Wireshark, identifying the contents of the selected frame and describing how 'encapsulation' is done by the different layers:
 1. In this frame, assume that the whole ICMP related information is considered to be the **data portion** of this frame.
 - a. What is the size (in bits/bytes) of this data portion?

2. Describing how this data portion is **first** encapsulated:
 - a. State at which layer of the network reference model this encapsulation is done and where (where in PC1) it is done.
 - b. What is the associated protocol in this layer?
 - c. What is the size (in bits/bytes) of the control information (header fields) added by this layer?
 - d. List the control information (header fields) added by this layer.
 - e. State the source and destination addresses in this header.
 - f. State whether these addresses are IP addresses (Layer 3 addresses) or MAC addresses (Layer 2 addresses).
 - g. Check with the addresses that you marked in part-1 and state whether the addresses are correctly specified in this header or not.
 3. Assume that the whole information of the data portion and the header fields encapsulated above (the first encapsulation) is referred to as a **packet**.
 - a. Refer to the Routing tables that you provide in part-2 and describe the steps/actions that take place after the packet is formed.
 - b. Refer to the Routing tables and briefly describe how the packet is passed on to the respective network interface card/module towards the destination.
 4. From the Wireshark output, describing how the packet is further encapsulated (the second encapsulation):
 - a. State where (which component/device of PC1) this encapsulation occurs and at which layer of the network reference model this encapsulation is done.
 - b. What is the associated protocol in this layer?
 - c. What is the size (in bits/bytes) of the control information (header fields) added by this layer?
 - d. List the control information (header fields) added by this layer.
 - e. State the source and destination addresses in this header.
 - f. State whether these addresses are IP addresses (Layer 3 addresses) or MAC addresses (Layer 2 addresses).
 - g. Check with the addresses that you marked in part-1 and state whether the addresses are correctly specified in this header or not.
 5. Draw the frame with its different encapsulations and mark/label the IP addresses and MAC addresses at the correct places.
 6. With the assumption that the whole ICMP related information is considered to be the **data portion** of this frame, give the ratio (or percentage) of full control message size (headers) to the frame size.
- c. Analyzing the trace-file at PC2 (CO223_Lab3_3a_PC2) and ensuring that the selected frame is correctly received by PC2.
1. What is the frame no. (in your trace) of the selected frame that is sent from PC1 and received by PC2? (In your report, attach a screenshot of the Wireshark panes with the selected frame)
 2. [Homework] In *Part-3.b.4.e*, you mentioned the source and destination addresses in the header. How does the PC1 find this destination address, in the first place, to fill in the header? Briefly state your answer. (Hint: Search through the trace-file 'CO223_Lab3_3a_PC1' with no filtering and find how the destination MAC address is found)