

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

### 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.
- Submit, within a week from your practical session, a report which addresses each question.
- 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.

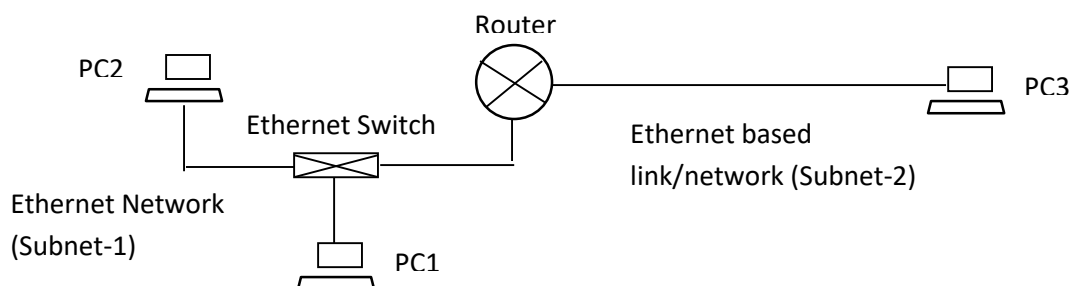


Fig. 1 A network scenario

### Part-1: IP addresses and MAC addresses

- a. Check the network set up in the lab (Fig. 1) and find IP and MAC addresses of the interfaces/devices. Mark/label the following IP and MAC addresses on Fig. 1.

IP address	MAC address
- Subnet-1:	- PC1:
- Subnet-2:	- PC2:
- PC1:	- PC3:
- PC2:	- MAC addresses associated to the Router:
- Router's Interface on Subnet-1	
- Router's Interface on Subnet-2:	
- PC3:	

### Part-2: Routing tables (IP tables)

- a. Find routing tables at PC1, PC2, PC3, and Router. Describe the different rows, columns, entries in the tables:  
 Routing table @ PC1:      Routing table @ PC2:      Routing table @ PC3:      Routing Table @ Router:

### **Part-3: Encapsulation, the use of routing tables, and Layers working together**

#### ***Web surfing: Sending a web-request from PC2 (web-client) to PC3 (web-server)***

- a. Send a 'web request' from PC2 to PC3 to download contents (e.g., a picture + texts). Use Wireshark at PC2 and PC3 to capture frames sent and received. Save trace-files (names: CO223\_Lab3\_PC2, CO223\_Lab3\_PC3).
- b. Using the trace file from PC2 ('CO223\_Lab3\_PC2'), select the frame associated to the 'HTTP request'. Give the frame no. in your trace. (In your report, attach a screenshot of Wireshark panes with the selected frame).  
**(Use the selected frame in the Wireshark to answer the following questions)**
- c. Find the **data** (HTTP request) In the selected frame:
  - How is the HTTP request (data) specified? (give few lines)
  - What is the size (in bits/bytes) of this data portion?
- d. Find the different levels of encapsulation on the 'data' seen above by filling the following table (use a separate sheet). Use Wireshark outputs to fill. Fill one level at a time in order (1<sup>st</sup> level, 2<sup>nd</sup>, and 3<sup>rd</sup>).

1<sup>st</sup> level encapsulation: The **data** is first encapsulated by **header-1**.

2<sup>nd</sup> level encapsulation: The '**data + header-1**' is further encapsulated by **header-2**.

3<sup>rd</sup> level encapsulation: The '**data + header-1 + header-2**' is further encapsulated by **header-3**.

	<b>1<sup>st</sup> level encapsulation</b>	<b>2<sup>nd</sup> level encapsulation</b>	<b>3<sup>rd</sup> level encapsulation</b>
<b>What is the payload of this layer?</b>			
<b>State where this encapsulation is done:</b> <ul style="list-style-type: none"><li>- Where in PC2?</li><li>- At which layer?</li></ul>			
<b>Details of the control information (header fields) added by this layer (you may omit a field, if irrelevant for this encapsulation):</b> <ul style="list-style-type: none"><li>- Associated protocol in this layer:</li><li>- Source port no.: (explain what this is)</li><li>- Destination port no.: (explain what this is)</li><li>- Protocol type: (explain what this is)</li><li>- Source address:</li><li>- Destination address:</li><li>- State whether the above addresses are IP addresses or MAC addresses.</li><li>- Other control information:</li></ul>			
<b>What is the size (in bits/bytes) of the control information (header fields) added by this layer?</b>			
<b>How do you call the payload + header?</b>			

- e. For the selected frame, give the ratio (or percentage) of full control message size (headers) to the frame size.
- f. Draw the frame with its different encapsulations and mark the IP and MAC addresses (as seen in the table above) at correct places.

- g. Compare the IP and MAC addresses marked above with the addresses that you labelled on Fig. 1 in part-1.
  - Verify whether the addresses in the headers are correctly specified.
  - Give reasons for the selection of the destination MAC address seen using the routing table @ PC2 (part-2).
  - [Homework] How does PC2 find this destination MAC address? (Hint: Search the file 'CO223\_Lab3\_PC2').
- h. Consider that the frame sent by PC2 is received by the Router. Briefly describe how the Ethernet header is processed and the packet is passed on to the IP layer at the router.
- i. Refer to the routing table @ Router (that you provided in part-2) and the destination IP address. Describe the steps/actions that take place at the IP layer of the router. Particularly describe how it identifies the correct router-interface/NIC to which the packet should be sent to.
- j. At the router-interface/NIC identified above, encapsulation is done and a frame is formed & sent. Guess and draw this frame with its different encapsulations and mark the IP and MAC addresses at correct places.
- k. Analyze the trace-file at PC3 (CO223\_Lab3\_PC3) to ensure that the destination (web-server) received this frame (above).
  - What is the frame no. (in your trace) of the selected frame that is sent from PC2 and received by PC3? (In your report, attach a screenshot of the Wireshark panes with the selected frame)
  - Check the IP addresses and the MAC addresses of this frame in the Wireshark and verify that they are the same as you provided for Question j above.
- l. Write the **components (e.g., PC1/PC2/PC3/Router-NIC1/Router-NIC2)** associated to the addresses seen when sending data from (1) PC2 to Router, and (2) Router to PC3:

Sending data from PC2 to Router	Sending data from Router to PC3
Component associated to the 'Source IP address':	Component associated to the 'Source IP address':
Component associated to the 'Destination IP address':	Component associated to the 'Destination IP address':
Component associated to the 'Source MAC address':	Component associated to the 'Source MAC address':
Component associated to the 'Destination MAC address':	Component associated to the 'Destination MAC address':

- m. Explain how layers work together:
  - Describe how both the two addressing schemes (IP addresses and MAC addresses) are effectively used in order to transmit through different networks/subnets (you may refer to the table you filled for Question l).
  - How do you describe that different layers work together in the above PC2 to PC3 transmission?

### **Web surfing: Downloading web-contents**

- n. From the trace file from PC2 ('CO223\_Lab3\_PC2'), find the frame(s) which carries (carry) the contents (e.g., the picture + texts) that you see in the web-browser at PC2. (In your report, attach a screenshot of the Wireshark panes with the selected frame showing the contents).
- o. For the selected frame, give the ratio (or percentage) of full control message size (headers) to the frame size. Compare this ratio with the percentage provided for Question e. Give reasons if the two values are different.