CO-223
LABORATORY SESSION 3

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GROUP : 15

DATE : 21/03/2017

Part-1 IP addresses and MAC addresses

a)

IP address	MAC address
Subnet-1: 192.168.2.0/24	PC1: 00-16-35-66-66-03
Subnet-2: 192.168.3.0/24	PC2: 00-16-35-66-6A-CB
PC1: 192.168.2.2	PC3: 00-0B-2B-0E-D9-E1
PC2: 192.168.2.3	MAC addresses associated to the Router:
Router's Interface on subnet-1: 192.168.2.1	192.168.2.1 → 00-15-C6-84-A2-58
Router's Interface on subnet-2: 192.168.3.1	192.168.3.1 → 00-15-C6-84-A2-59
PC3: 192.168.3.2	

Table 1

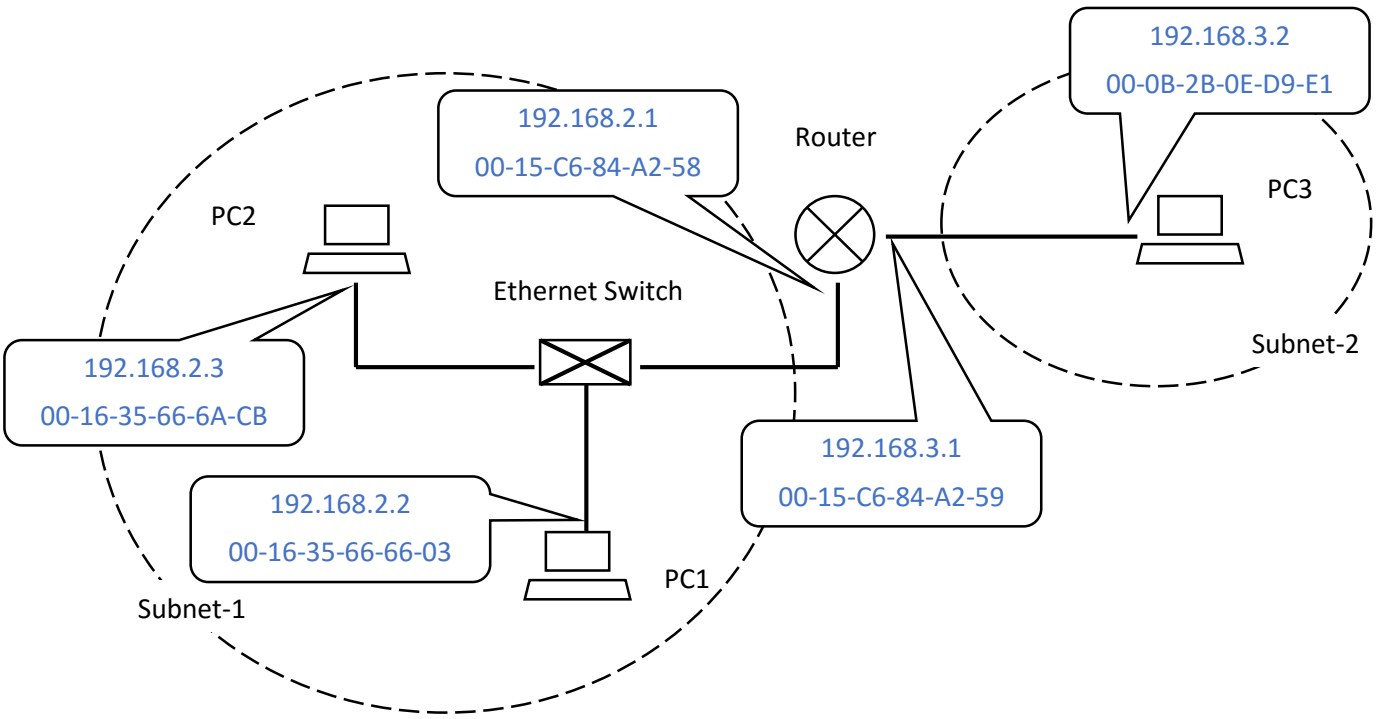


Figure 1A

Part-2: Routing Table (IP tables)

a) Routing table @ PC1:

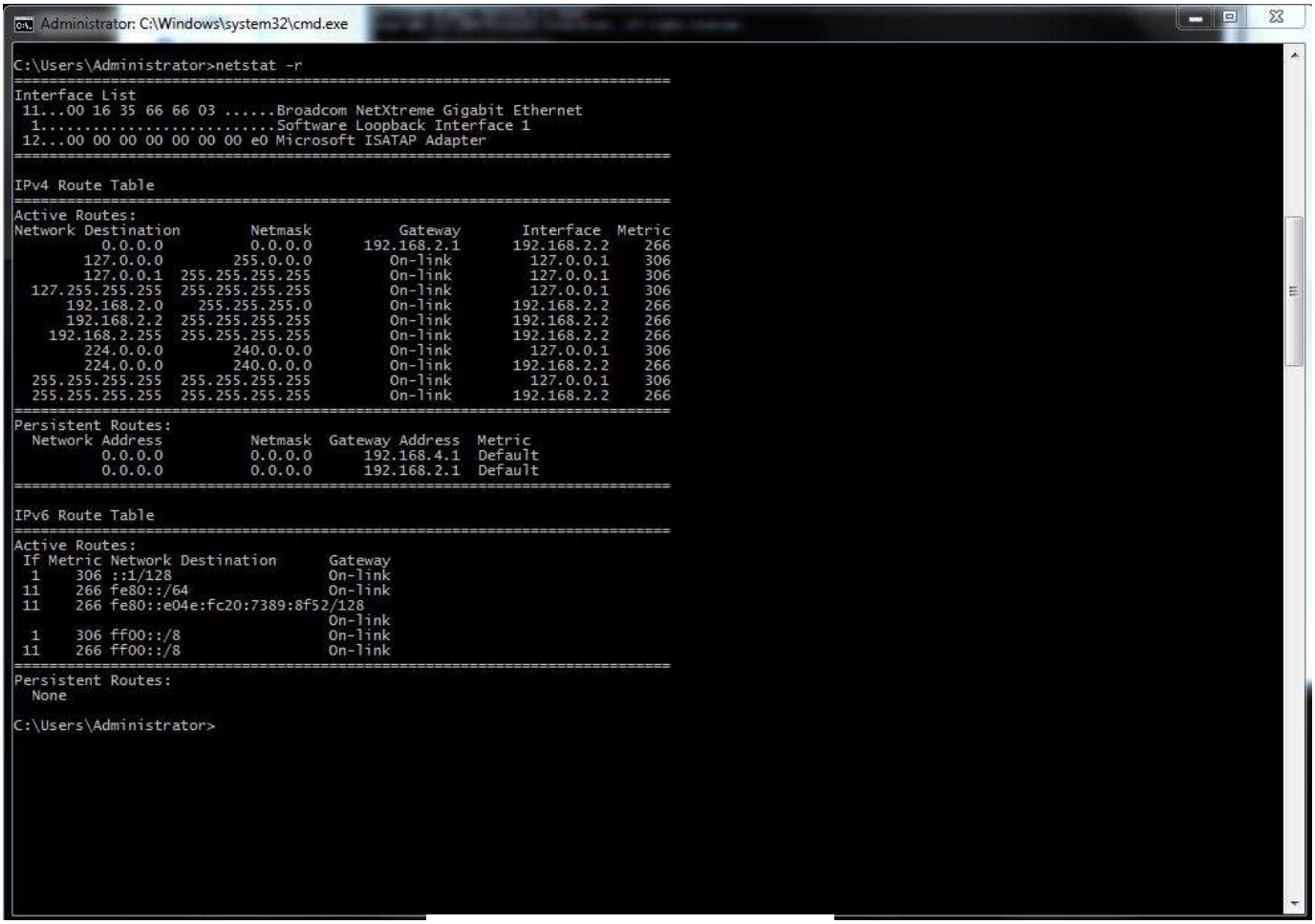


Figure 2A : Routing table PC1

b) Routing table @ PC2:

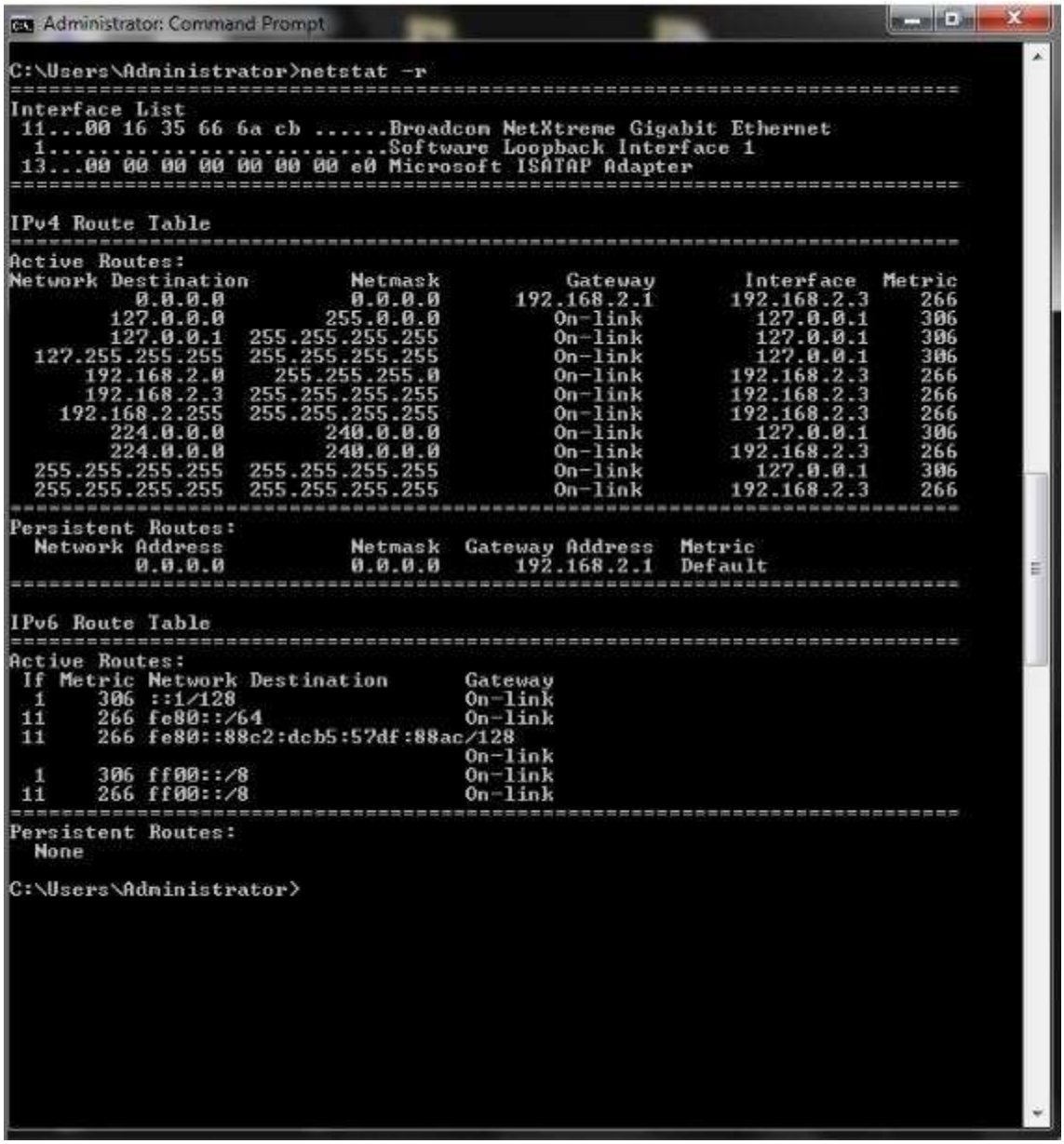


Figure 2B : Routing table PC2

c) Routing table @ PC3:

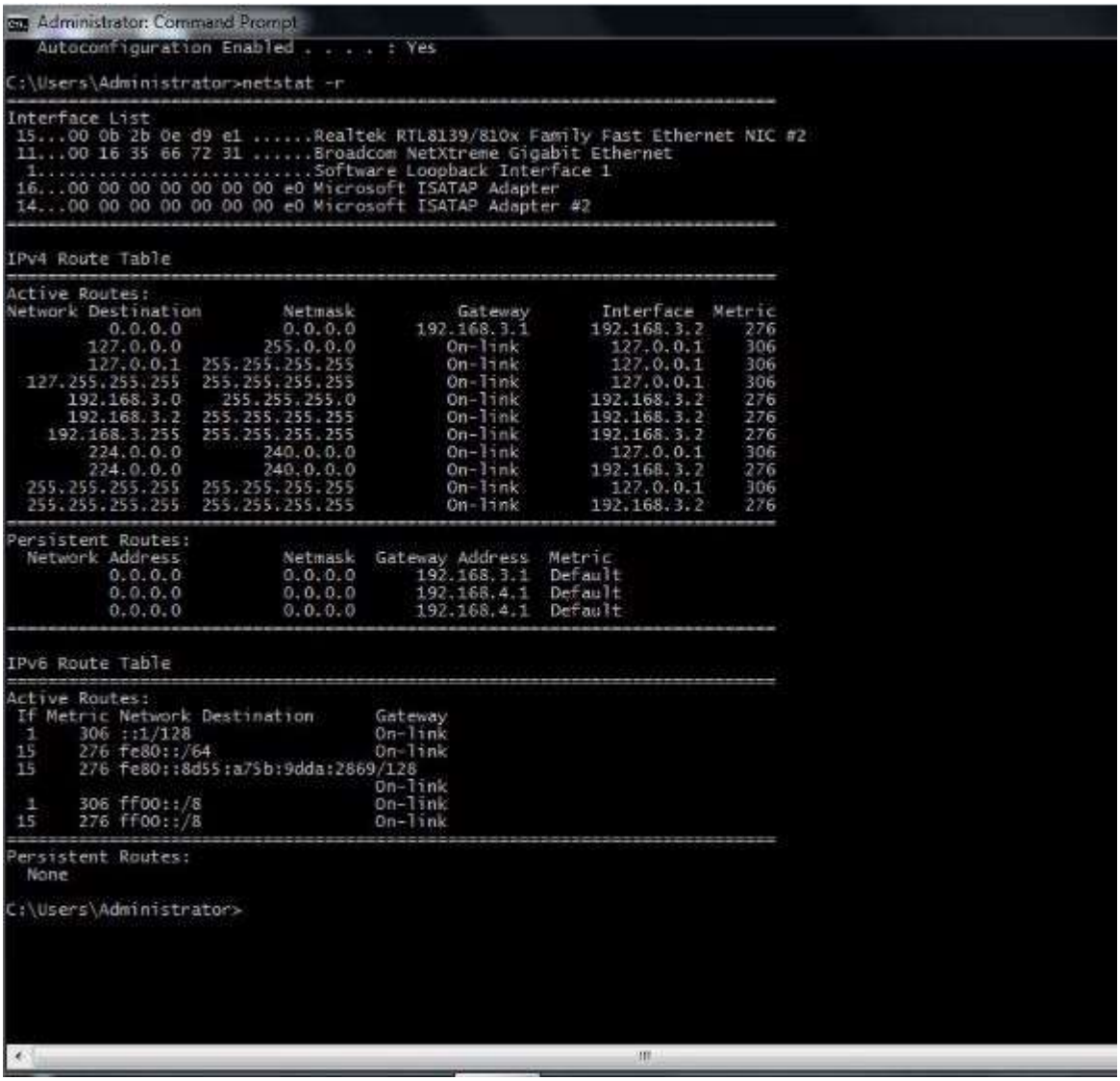


Figure 2C : Routing table PC3

When considering about columns in IPv4 routing tables on PCs there are 5 main columns.

- Network destination – Destination IP which the packets are to be forwarded.
- Netmask – in this column it shows whether packets are to be broadcast or send in default route. Ex: 0.0.0.0 is the default netmask address
  255.255.255.255 is the broadcast address
- Gateway – gateways shows whether the next destination is within the subnet or if not what is the way out towards the final destination

- Interface – this column shows the interfaces which are locally available in order to reach the gateway.
- Metric – when multiple routes are available this metric is used to choose the route. Lowest metric valued route will always be chosen.

  First row in the table indicates the default situation, which have the router's interface on the subnet as the gateway. Except this situation there are no any specified gateways as all are linked.

  Fifth row indicates the route for packets that are to be transferred within the subnet.

  Sixth row shows the packets received to the pc itself. They are directed towards their own IP.

  Last row shows packets that are to be broadcast. They should be return to the router in order to broadcast.

d) Routing table @ Router:

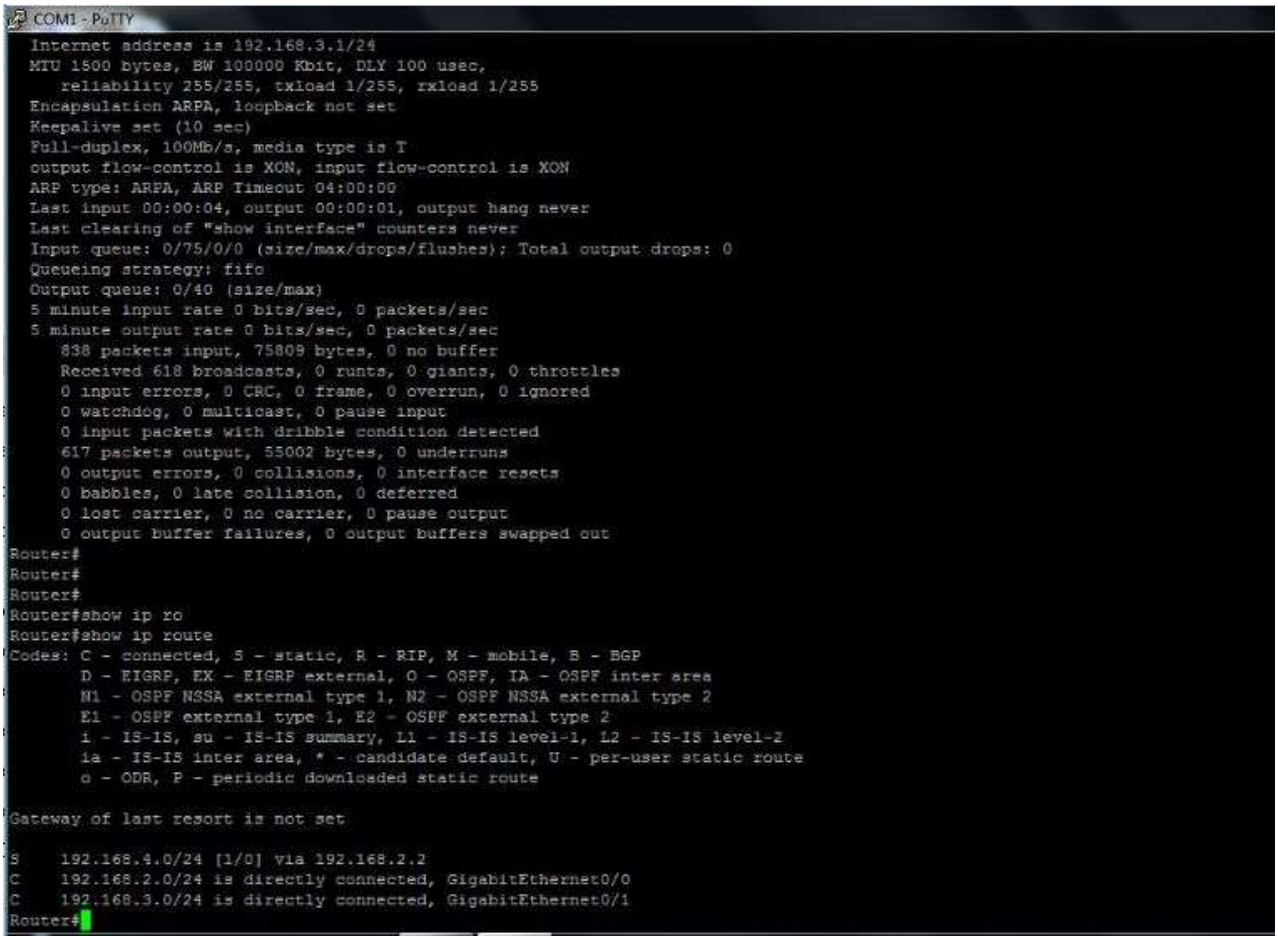


Figure 2D : Routing table Router

In the routing table of router in the beginning and in mid part packets status and many other information related to packet transferring are shown.
At the end connected subnets and their status are shown.

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

b)

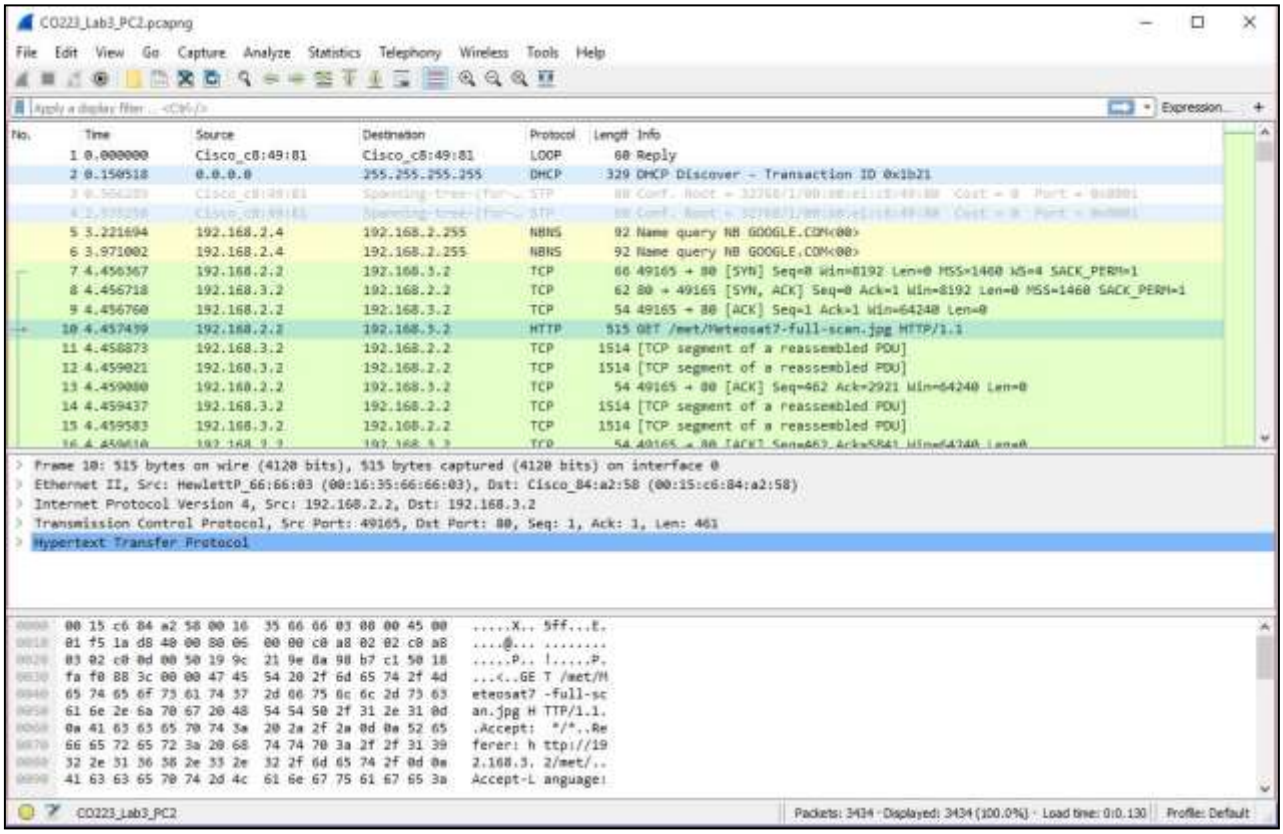


Figure 3A : HTTP Request PC2

Frame no. of the http request is10.

c)

- The HTTP request data is specified by adding commands ‘GET/met/’.
- 515 bytes in size

d)

	1st level encapsulation	2nd level encapsulation	3rd level encapsulation
What is the payload of this layer?	Data + header-1	Data + header-1 + header-2	Data + header-1 + header-2 + header-3
State where this encapsulation is done:			
Where in PC1?	In Operating system	In Operating system	In Network Interface Card
At Which layer?	At transport layer	At network layer	At physical layer
Details of the control information (header fields) added by this layer:			
Associated Protocol in this layer:	TCP	IP	Ethernet
Source port no:	49165	-	-
Destination port no:	80	-	-
Protocol type:	Connection oriented There is a fixed path to transfer the packets.	Connection-less There is no fixed path to transfer packets.	Connection-less There is no fixed path to transfer packets.
Source address:	-	192.168.2.2	00:16:35:66:66:03
Destination address:	-	192.168.3.2	00:15:C6:84:A2:58
State whether the above addresses are IP addresses or MAC addresses:	-	IP addresses	MAC addresses
Other control information:	TCP segment length : 461	Total length:501 TTL = 128	-
What is the size (in bits/bytes) of the control information (header fields) added by this layer?	20 bytes	20 bytes	14 bytes
How do you call the payload+header?	Segment	Datagram	Frame

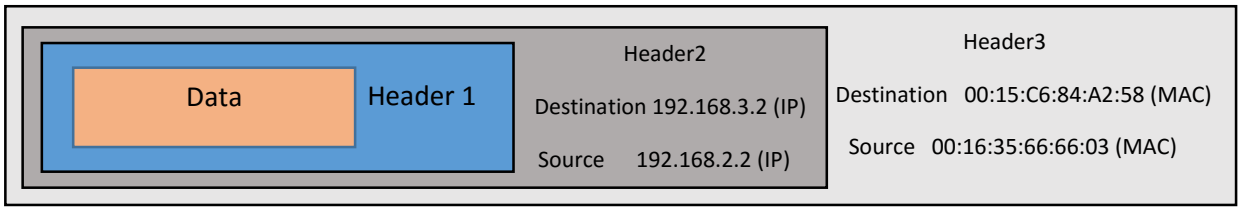
e)

$$\text{Percentage} = \frac{\text{size of header1} + \text{size of header2} + \text{size of header3}}{frame\ size} \text{ x } 100\%$$

$$\text{Percentage} = \frac{20 + 20 + 14}{515} \text{x} 100\%$$

$$\text{Percentage} = 10.49\%$$

f)



g)

Part 1) a)		Part 3) f)	
Source	192.168.2.2 (IP)	Source	192.168.2.2 (IP)
Destination	192.168.3.2 (IP)	Destination	192.168.3.2 (IP)
Source	00:16:35:66:66:03 (MAC)	Source	00:16:35:66:66:03 (MAC)
Destination	00:15:C6:84:A2:58 (MAC) (MAC address of the router)	Destination	00:15:C6:84:A2:58 (MAC)

Table 2

Destination IP address is not in the same subnet of PC1. According to the routing table of PC1, it makes its decision to forward the packet to the default gateway (192.168.2.1). In order to send the packet to the particular IP, frame should be sent to the particular MAC address. Which is 00:15:C6:84:A2:58

PC1 contains a directory of MAC addresses and IP addresses of devices within the same subnet. PC1 can refer the particular IP and find the MAC address of certain device.

h) When the frame is received by the router, Ethernet header, which was put by the physical layer is processed and router recovers that the frame was sent by the physical layer of PC1 and its destination is physical layer of router.

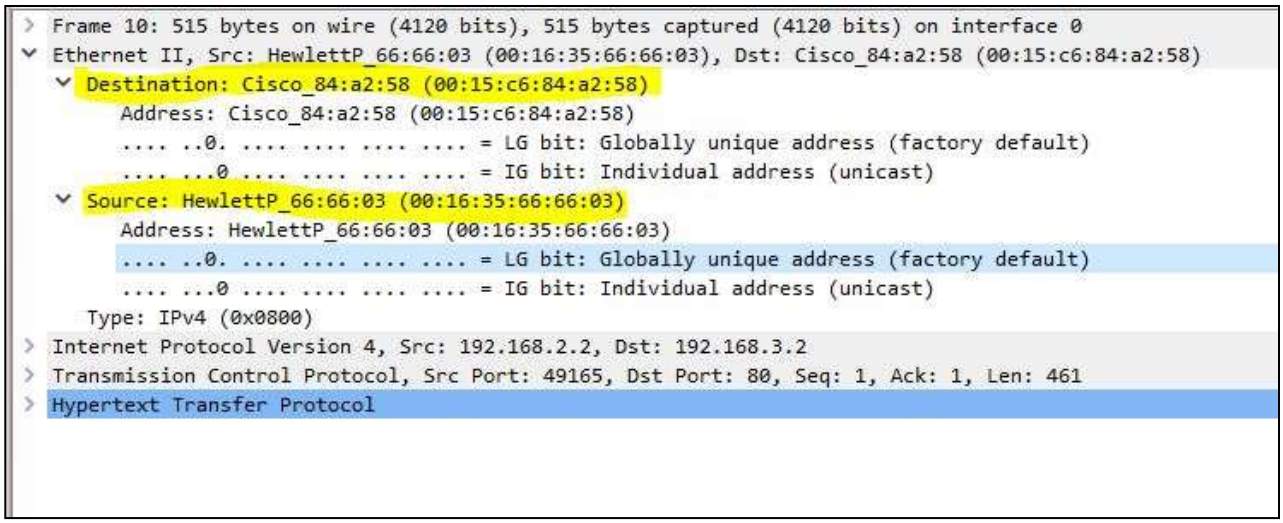


Figure 3B

Then, router's physical layer removes the 3rd level encapsulation and recover the IP address which the packet to be sent and send the packet to the IP layer.

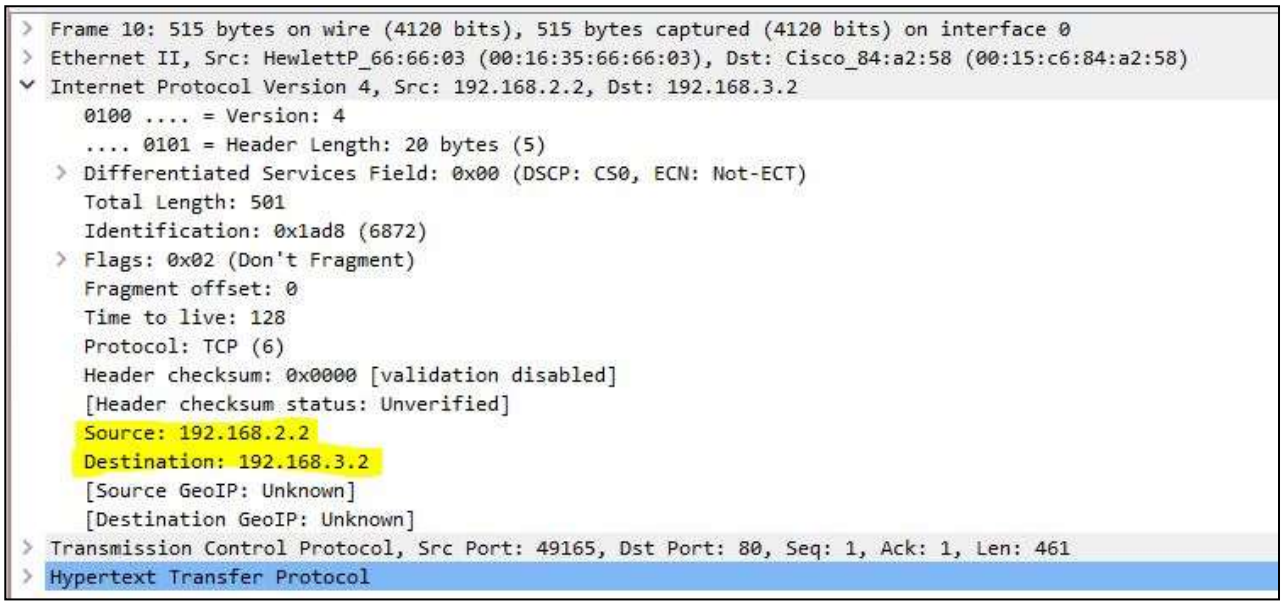


Figure 3C

i) Destination IP address that the IP layer of the router reads is 192.168.3.2
According to the routing table, IP layer of the router check whether to which subnet, 192.168.3.2 is referred to.

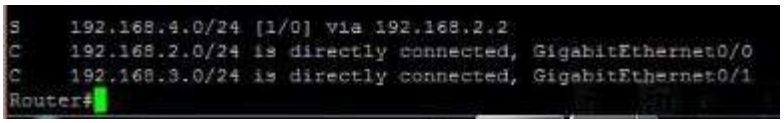
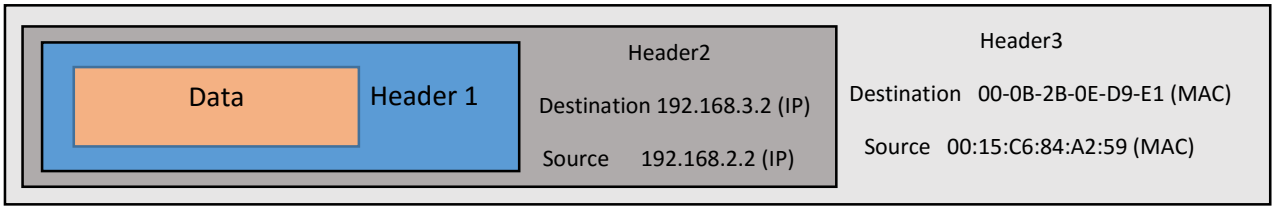


Figure 3D

Then, IP layer of the router identifies the subnet which 192.168.3.2 belongs to, and send the packet to the particular Ethernet interface. In this case it is GigabitEthernet0/1.

j)



k)

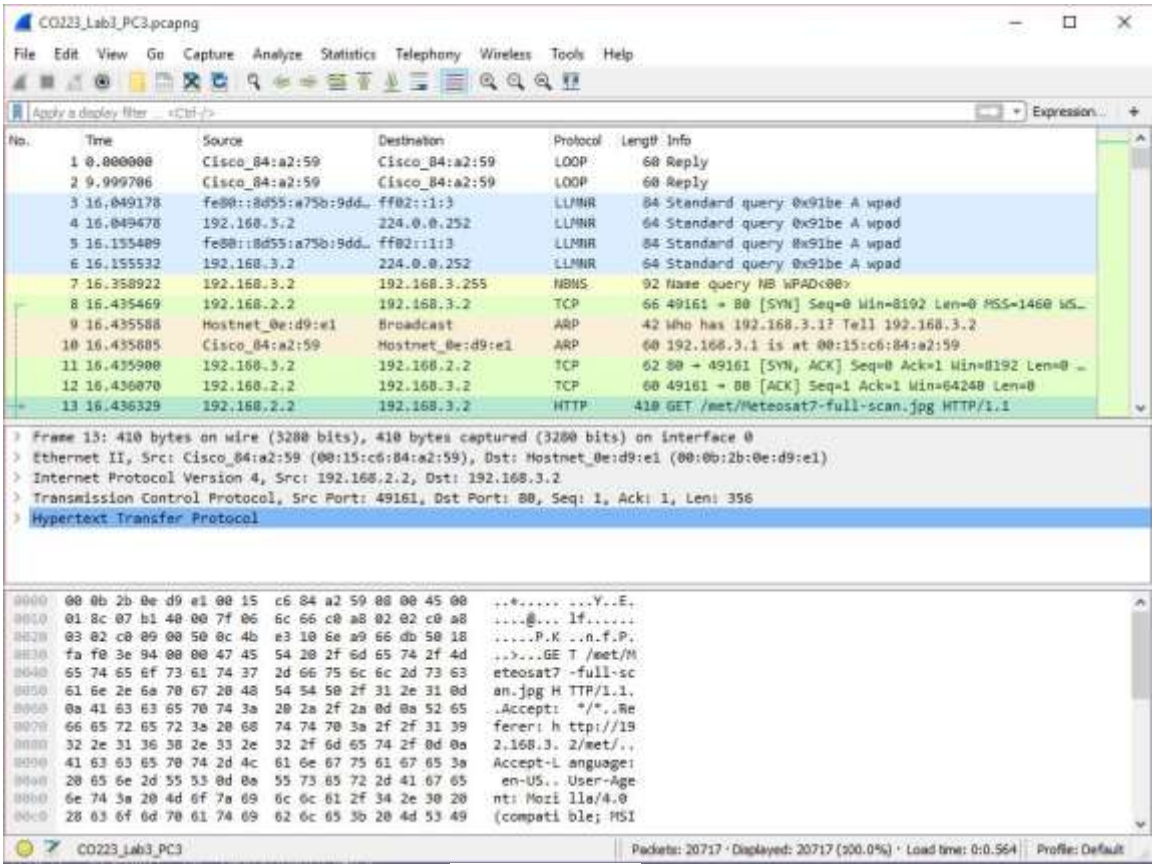


Figure 3E

Frame no. 13 is the frame which have sent from PC1

According to Figure 3E		According to question j)	
Source	192.168.2.2 (IP)	Source	192.168.2.2 (IP)
Destination	192.168.3.2 (IP)	Destination	192.168.3.2 (IP)
Source	00:15:C6:84:A2:59 (MAC)	Source	00:15:C6:84:A2:59 (MAC)
Destination	00:0B:2B:0E:D9:E1 (MAC)	Destination	00:0B:2B:0E:D9:E1 (MAC)

Table 3

l)

Sending data from PC1 to router	Sending data from router to PC3
Component associated to the 'Source IP address' : PC1	Component associated to the 'Source IP address' : Router-NIC2
Component associated to the 'Destination IP address' : Router-NIC1,PC1,PC3	Component associated to the 'Destination IP address' : Router-NIC2,PC3
Component associated to the 'Source MAC address' : PC1	Component associated to the 'Source MAC address' : Router-NIC2
Component associated to the 'Destination IP address' : Router-NIC1,PC1	Component associated to the 'Destination IP address' : Router-NIC2,PC3

Table 4

m)

- Consider an incident where PC1 is transferring a packet to PC3 which is not within the same subnet. In PC1, according to the destination IP address, destination MAC address is chosen. If IP is within the same subnet MAC address of particular IP can be obtained. If IP is referred to somewhere else, packet is forwarded towards the gateways so that packet can be directed to the subnet it belongs. In order to do that, MAC address of gateway interface should be obtain. MAC addresses are used locally within the subnet.

  Always gateway interfaces are belongs to a router. Router then obtain the MAC address of particular router interface which is connected to the PC3 by IP address. Then segment is forwarded to the physical interface of PC3. Then the packet is directed to the particular IP address.

- When network layer send the packet to the physical layer in PC1, it obtained the destination MAC address by referring the destination IP address. If the destination IP address is not within the same subnet MAC address would be the gateway interface (Router) MAC address. This process is done by the combination of both network layer and the physical layer. After forwarding the frame to the physical layer of the router, it process the header put by the PC1 and decide IP address that the segment to be forwarded. Then in the network layer of router packet is send to the connected physical layer in order to send to the particular IP address. Physical layer decides the physical interface that the segment to be forwarded with the help of network layer. At the end, physical layer of PC3 receives the frame and remove the header 3 and forward it to the particular IP address in network layer.

n)

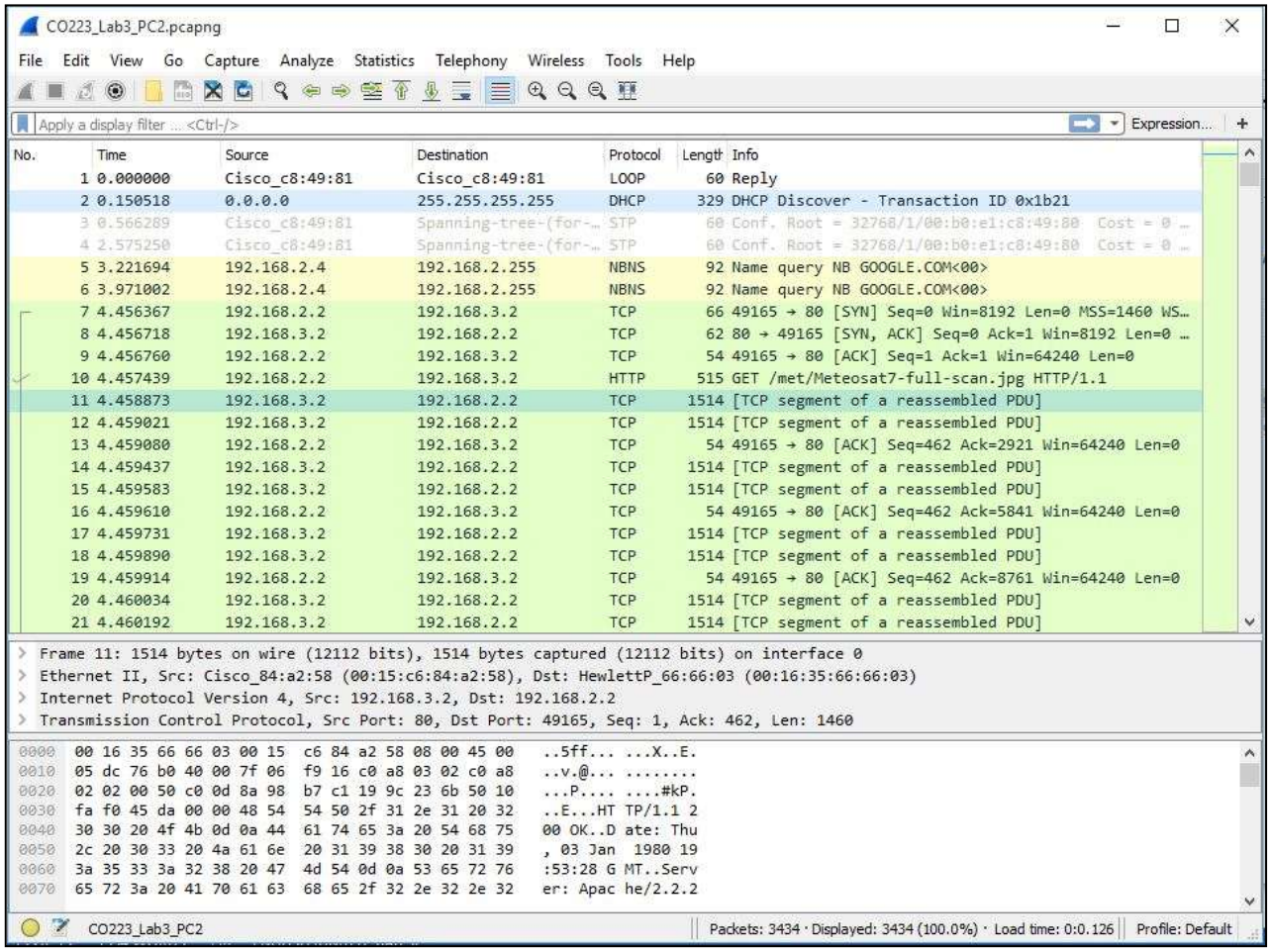


Figure 3F

TCP packets those are 1514 in length, are the packets which carry the contents. Destination is 192.168.2.2 and source is 192.168.3.2

o)

$$\text{Percentage} = \frac{\text{size of header1} + \text{size of header2} + \text{size of header3}}{frame\ size} \text{ x100\%}$$

$$\text{Percentage} = \frac{20 + 20 + 14}{1514} \text{ x 100\%}$$

Percentage = 3.66%

In question e. percentage was 10.49% and now the percentage is 3.66%. Reason for this difference is the different size of each datagram. Except that all the header sizes are same.