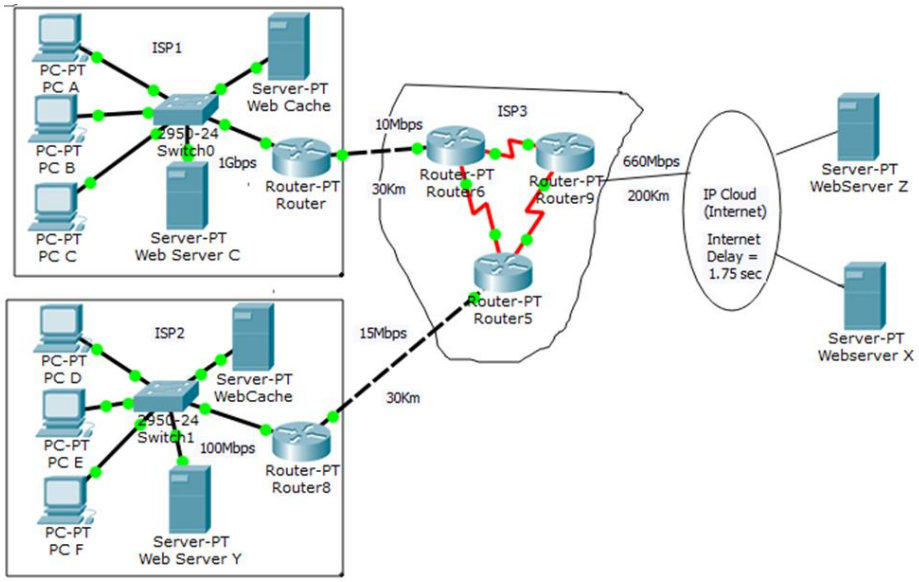


Figure 1

Q1. Briefly answer the following questions.

a) Derive an equation for end-to-end delay (do not calculate values) between Host (PC A) to Webserver X, shown in Figure 1. Use an appropriate variable notation where necessary. (2 marks)

b) If a packet is sent from the Host (PC A) to Webserver Z, what would be the reason for packet loss? (1 mark)

c) Why there are two different transport layer service models for network applications? (1 mark)

Q2.

a) Calculate total delay which Host (PC B) will experience while accessing a file of size 1Mbits from webserver Z with no web cache. Assume average Internet delay as 1.75 seconds, ISP # 3 delay as 0.85 seconds, and 18 requests offered to service ISP # 3 per second. The bandwidth of access link between ISP # 1 and ISP # 3 is 10 Mbps. Assume that this link is usable up to 90% of link capacity, and experiences infinite (unpredictable) delays otherwise. (2 marks)

b) Calculate the delay Host (PC D) will experience using web cache placed on the ISP # 2 LAN. Assume a cache hit ratio = 50%. (2 marks)

Q3. Assume that the webserver Z is accessed by a browser running on the Host (PC D). Draw below the series of packet exchanges that will occur for host to receive a file solution.zip completely. Include all packets – control and data – from relevant protocols. You do not need to write down message formats. Each packet is a labeled arrow, where the label has the protocol name and message type and the arrow starts from the source and ends at the destination for that packet. (4 marks)

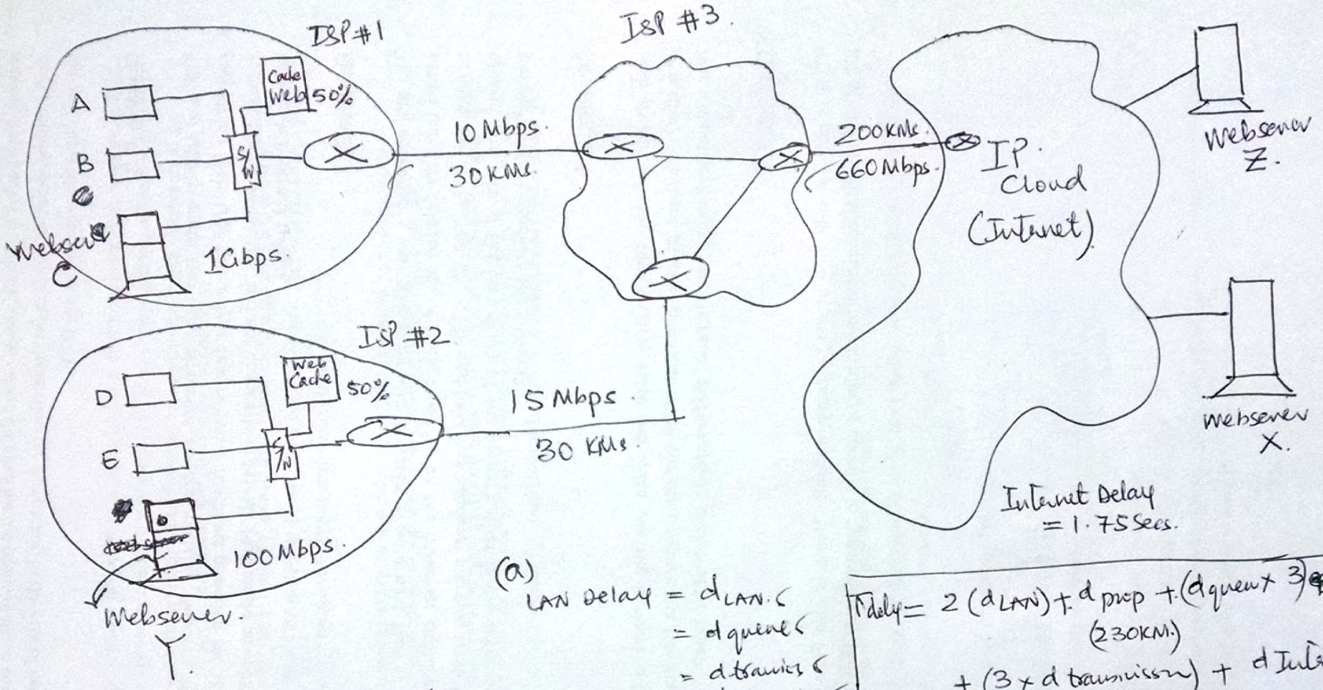
Q4. Suppose an application is running on the host (PC E) wants to send a message to webserver X. (2x2=4 marks)

a) Show how this message is processed at each TCP/IP layers ***at the sender***.

b) How this message is delivered to only ONE application process **at the receiver**? Explain.

Q5. Assume that Webserver Z hosts a shopping cart application. How cookies help an online store to identify returning customers to their website? Briefly explains the requirements to implement cookies on the client and server, and show all required interactions between client-server. (4 marks)

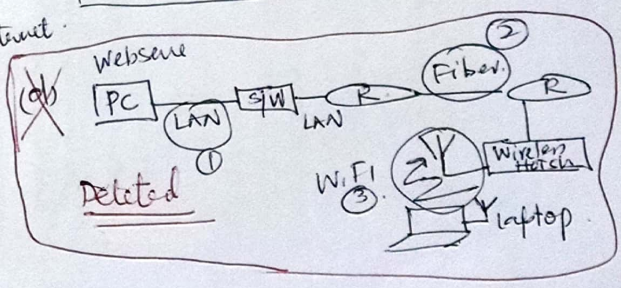
Q6. How client-server and peer-to-peer paradigms are different? Explain using labeled diagrams. (4 marks)



(a)

LAN Delay = d_{LAN}
= d_{queue}
= $d_{transmis}$
= d_{propa}
= $d_{Internet}$

$T_{delay} = 2(d_{LAN}) + d_{prop} + (d_{queue} \times 3) + (230KM.) + (3 \times d_{transmission}) + d_{Internet}$



(b) packet are lost in IP cloud due to Input/output queue in the route or due to bit error during transmission & memory. Frame are also lost at L2.

(c) Internet transport layer offer TCP & UDP Service models. TCP caters for application which are not lost tolerant but delay insensitive (like FTP, HTTP etc). and UDP caters for loss tolerant delay sensitive Apps.

Q2 Traffic Intensity LAN = $18 \times \frac{1 \times 10^6}{1 \times 10^8} = 0.018$ ~ < 10msec

(a) Traffic Intensity Access = $18 \times \frac{1 \times 10^6}{10 \times 10^6} = 1.8$ ~ unbounded. Traffic Intensity > 100% link capacity exceeded

Total Delay = LAN delay + Access link delay + ISP #3 Delay + Internet delay.

= 0.02 + unbounded + 0.85 + 1.75

= 2.62 + unbound.

(b) for web cache with a hit ratio of 50%.

= 0.50 (LAN Delay) + 0.5 (0.02 + 0.40 + 0.85 + 1.75)

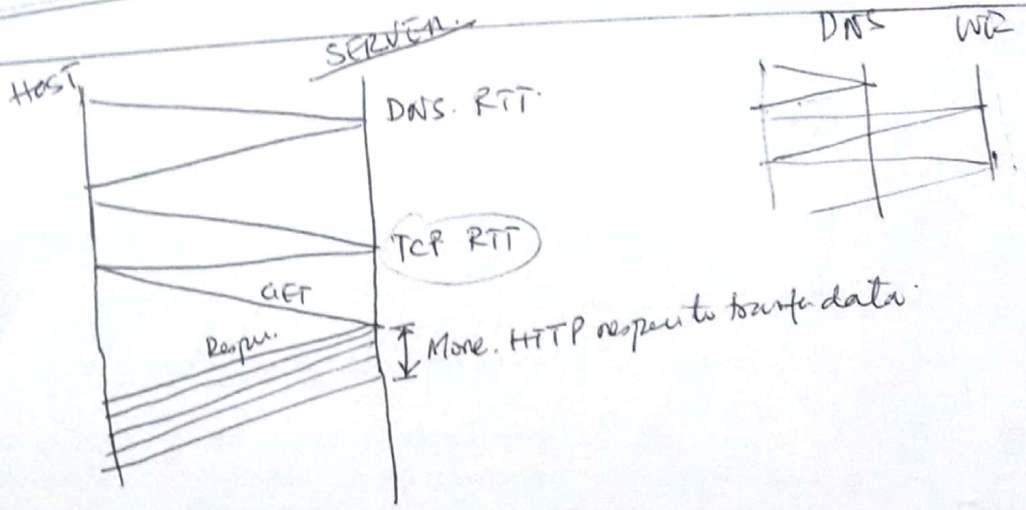
0.02

= 0.01 + 1.33.

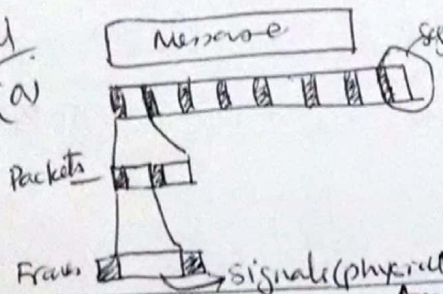
= 1.34 (with cache).

<90% when 40msec delay on Access link. as per link.

Q3

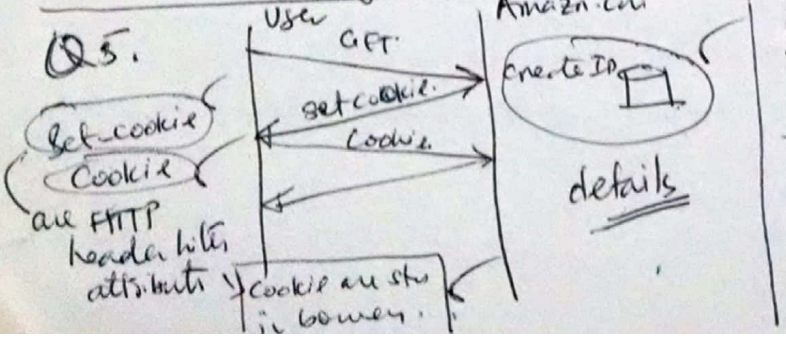


Q4 (a)

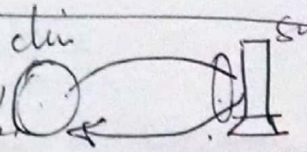


(b) Transport layer add a port # along with IP address. Port # ensure delivery from a some process to destination process using sockets.

Q5.

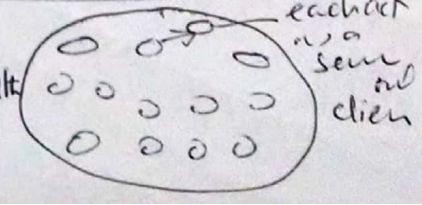


Q6.



> client bandwidth req at server increase

more clients result in more bandwidth and compute & storage Resources



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