COMSATS University Islamabad (CUI)

Department of Computer Science

CSC339- Data Communication and Computer Networks

BSE-5B FALL 2021

Assignment-2

Due Date: November 10, 2021

Question 1 **Marks 1.5**

Suppose a process in Host C has a UDP socket with port number 6789. Suppose both Host A and Host Beach send a UDP segment to Host C with destination port number 6789. Will both of these segments be directed to the same socket at Host C? If so, how will the process at Host C know that these two segments originated from two different hosts?

Ans:

Yes, both segments has to be directed to the same socket. At the socket interface, for each received segment, the processes will be provided with the IP addresses by the OS which will help in finding that the two packets were originated from the two different hosts.

Question 2 **Marks 1.5**

Consider Host A sends two TCP segments back-to-back to Host B over a TCP connection. The first segment has sequence number 90; the second has sequence number 110.

a) How much data is in the first segment?
b) Suppose that the first segment is lost but the second segment arrives at B. In the acknowledgment that Host B sends to Host A, what will be the acknowledgment number?

Ans: The sequence number of the first Byte of first segment = 90
The sequence number of the first Byte of second segment = 110

which implies, The sequence number of the last Byte of first segment = (110-90) = 109

a) Therefore, number of Bytes in the segment is (109-90+1 = 20)

b) Ack number will be 90 since the first segment is lost.

Question 3 **Marks 3**

a) Assume you have the following 2 bytes: 01011100 and 01100101. What is the 1s complement of the sum of these 2 bytes?

b) Assume you have the following 2 bytes: 11011010 and 01100101. What is the 1s complement of the sum of these 2 bytes?

c) For the bytes in part (a), give an example where one bit is flipped in each of the 2 bytes and yet the 1s complement doesn't change.

Ans:
(01011100 + 01100101) = 11000001
Adding the two bytes gives 11000001.
Taking the ones complement = 00111110

b) Assume you have the following 2 bytes: 11011010 and 01100101. What is the 1s complement of the sum of these 2 bytes?
Solution:
(11011010 + 01100101) =01000000
Adding the two bytes gives 01000000.
Taking the ones complement gives 10111111.

c) For the bytes in part (a), give an example where one bit is flipped in each of the 2 bytes and yet the 1s complement doesn't change.
Solution:
First byte = 01010100
Second byte = 01101101

Question 4 **Marks 3**

Consider distributing a file of $F = 15$ Gbits to N peers. The server has an upload rate of $u_s = 30$ Mbps and each peer has a download rate of $d_i = 2$ Mbps and an upload rate of u. For $N = 10$ and 100 and $u = 300$ Kbps and 700 Kbps. Please prepare a chart giving the minimum distribution time for each of the combinations of N and u for both client-server distribution and P2P distribution.

Ans:

- For calculating the minimum distribution time for client-server distribution, we use following formula:
  D_{cs}=max{ NF/u_s , F/d_{min} }
- Similarly formula for calculating the minimum distribution time for P2P distribution:

D_{P2P}=max{ F/u_s , F/d_{min} , $NF/(u_s+\sum_{i=1}^{N} ui)$}

- ❖ F=15Gbits =15*1024Mbits , u_s=30,Mbps , d_{min}=d_i=2Mbps

Client Server:

		N	
		10	100
	300 Kbps	7680	51200
u	700 Kbps	7680	51200

Peer to Peer:

		N	
		10	100
	300 Kbps	7680	25904
u	700 Kbps	7680	15616

<u>Question 5</u> Marks 3

Suppose that the two measured SampleRTT values are 100ms and 110ms, assuming that the value of EstimatedRTT was 80ms just before the first of these two samples were obtained. Use the values of α = 0.25, and β = 0.125. Round your answers to two decimal places after leading zeros. Answer the following.

a) What is the EstimatedRTT after each SampleRTT?
b) What is the RTT Deviation after each SampleRTT?
c) What is the TCP timeout after each SampleRTT?

Ans:

a). What is the EstimatedRTT after each SampleRTT?

EstimatedRTT = α * SampleRTT + (1- α) * EstimatedRTT

= 0.25 * 100 + (1 – 0.25) * 80

= 25 + (0.75) * 80 = 85 ms

EstimatedRTT = α * SampleRTT + (1- α) * EstimatedRTT

= 0.25 * 110 + (1 – 0.25) * 80

= 27.5 + (0.75) * 80

= 87.5 ms b.

b). What is the RTT Deviation after each SampleRTT?

DeviationRTT = β * | SampleRTT – EstimatedRTT | + (1 - β) * DeviationRTT

= 0.125 * | 100 – 85 | + (1 - 0.125) * 10

= 0.125 * |15| + (0.875) * 10 = 1.875 + 8.75

= 10.625 ms = 10.63 ms

DeviationRTT = β * | SampleRTT – EstimatedRTT | + (1 - β) * DeviationRTT

= 0.125 * |110 – 87.5| + (1 – 0.125) * 10

= 0.125 *| 22.5 | + (0.875) *10

= 2.8125 + 8.75 = 10.9325 ms = 10.93 ms

c).What is the TCP timeout after each SampleRTT?

TimeOut = EstimatedRTT + 4DevRTT

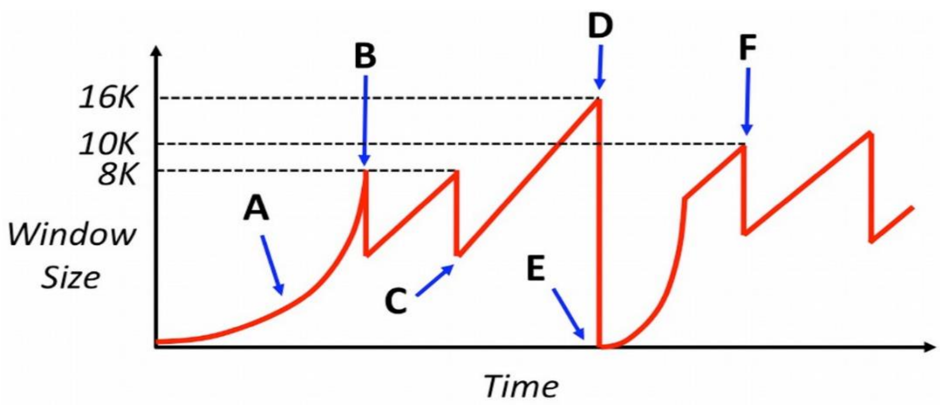
= 85 + 4 * 10.63 = 127.52 ms

TimeOut = EstimatedRTT + 4DevRTT

= 87.5 + 4 * 11.56 = 133.74 ms

Question 6 **Marks 3**

Consider the following graph where the y-axis shows the sender's TCP window size and the x-axis provides the behaviour of TCP working.



a) What behavior is observed in A? Provide reason
b) What caused the decrease in window size at point B? Provide reason.
c) What caused the decrease in window size at point D?
d) Describe the behaviour from point E to F?

Ans:

1. What behavior is observed in A? Provide reason.

This behavior in A shows the slow-start period quickly discovers the maximum acceptable throughput that the path supports.

2. What caused the decrease in window size at point B? Provide reason.

Triple duplicate ACK caused the decrease in window size at point B.

3. What caused the decrease in window size at point D?

Timeout caused the decrease in window size at point D.

4. Describe the behavior from point E to F?

At E to F, shows the behavior of slow start and will increase until it will reach thread where it start congestion control.

<u>Question </u>7 Marks 3

Suppose an organization is granted a block of addresses with the beginning address 14.14.74.0/24. There are 256 addresses in this block. The organization needs to have 11 subnets as shown below:

a) 2 subnets, each with 64 addresses
b) 2 subnets, each with 32 addresses
c) 3 subnets, each with 16 addresses
d) 4 subnets, each with 4 addresses

Design the subnets, subnet and broadcast address, subnet id etc. (To simplify your work, assume all 0-s and all 1- s subnet ID are allowed)

Ans:

a) 2 subnets, each with 64 addresses

We use first 128 addresses for first two subnets each with 64 addresses. Note that mask for each subnet is /26.

b) 2 subnets, each with 32 addresses

We use first 64 addresses for first two subnets each with 32 addresses. Note that mask for each subnet is /27.

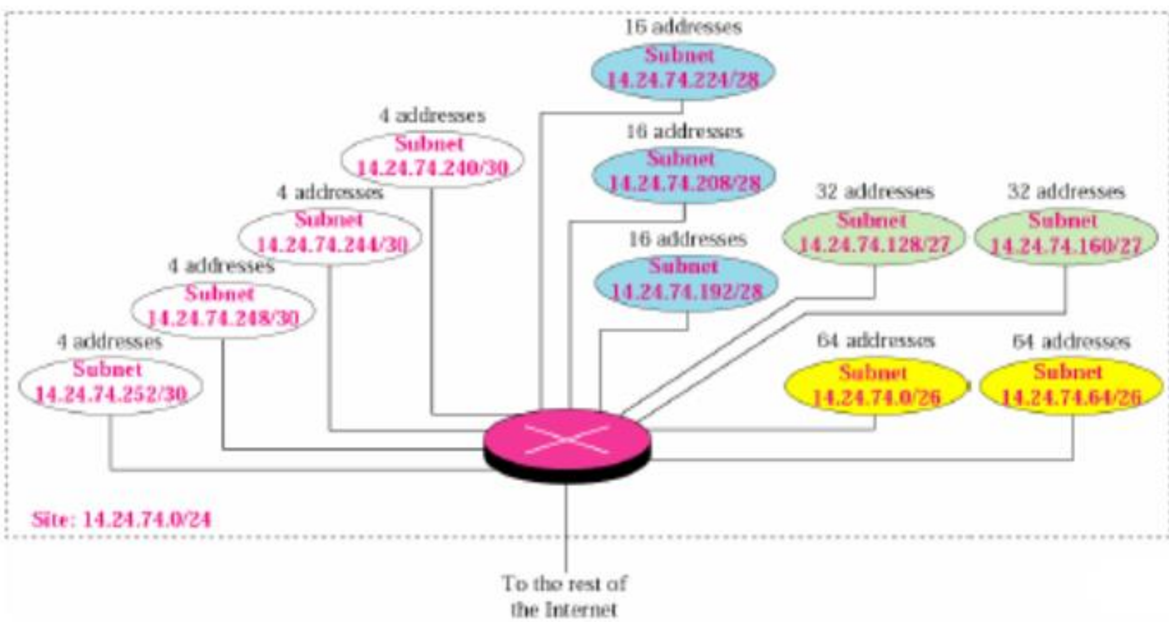
c) 3 subnets, each with 16 addresses

We use first 48 addresses for first two subnets each with 16 addresses. Note that mask for each subnet is /28.

d) 4 subnets, each with 4 addresses

Design the subnets, subnet and broadcast address, subnet id etc. (To simplify your work, assume all 0-s and all 1- s subnet ID are allowed)

We use first 16 addresses for first two subnets each with 4 addresses. Note that mask for each subnet is /30.

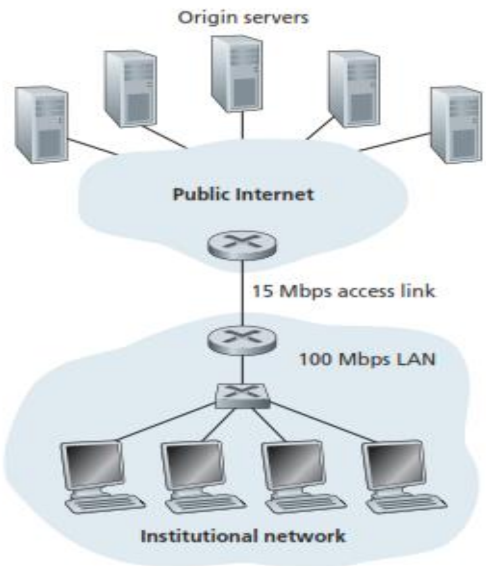


Question 8 **Marks 2**

Consider Figure below, for which there is an institutional network connected to the Internet. Suppose that the average object size is 850,000 bits and that the average request rate from the institution's browsers to the origin servers is 16 requests per second. Also is assumed that the amount of time it takes from when the router on the Internet side of the access link forwards an HTTP request until it receives the response is three seconds on average. Model the total average response time as the sum of the average access delay (that is, the delay from Internet router to institution router) and the average Internet delay. For the average access delay, use $\Delta/(1-\beta\Delta)$, where Δ is the average time required to send an object over the access link and β is the arrival rate of objects to the access link.:

a) Find the total average response time.

b) Now suppose a cache is installed in the institutional LAN. Suppose the miss rate is 0.4. Find the total response time.



Ans:

a) Find the total average response time.

The time to transmit an object of size L over a link or rate R is L/R. The average time is the average size of the object divided by R:

Δ = (850,000 bits)/(15,000,000 bits/sec) = .0567 sec

The traffic intensity on the link is given by $\beta\Delta$= (16 requests/sec)(.0567 sec/request) = 0.907.

Thus, the average access delay is (.0567 sec)/(1 - .907) ≈ .6 seconds.

The total average response time is therefore .6 sec + 3 sec = 3.6 sec.

b) Now suppose a cache is installed in the institutional LAN. Suppose the miss rate is 0.4. Find the total response time.

The traffic intensity on the access link is reduced by 60% since the 60% of the requests are satisfied within the institutional network. Thus

Average access delay = (.0567 sec) / [1 – (.4)(.907)] = .089 seconds.

The response time is approximately zero if the request is satisfied by the cache (which happens with probability .6);

The average response time is .089 sec + 3 sec = 3.089 sec for cache misses (which happens 40% of the time).

So, the average response time is (.6)(0 sec) + (.4)(3.089 sec) = 1.24 seconds. Thus, the average response time is reduced from 3.6 sec to 1.24 sec