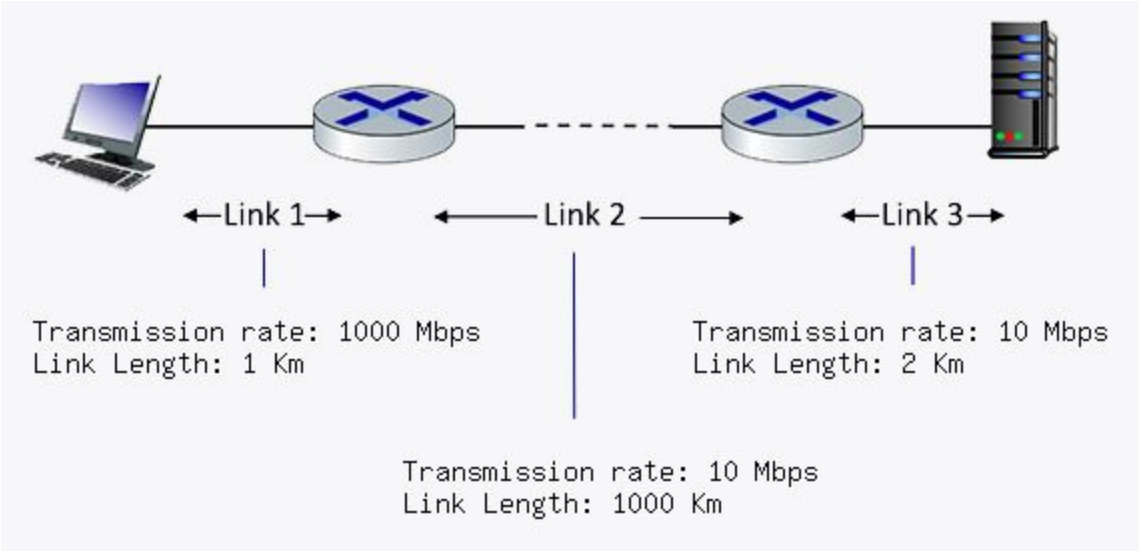
CS358 – Computer Networks
Mid-Semester Assignment - 2021

All Questions are compulsory. **Maximum – 70 Marks**

1. Consider the figure below, with three links, each with the specified transmission rate and link length. Assume the length of a packet is 8000 bits. The speed of light propagation delay on each link is 3x10^8 m/sec. **(2 x 5 = 10 Marks)**



Answer the following questions.

a. What is the total delay?

b. What is the total delay of link 1?

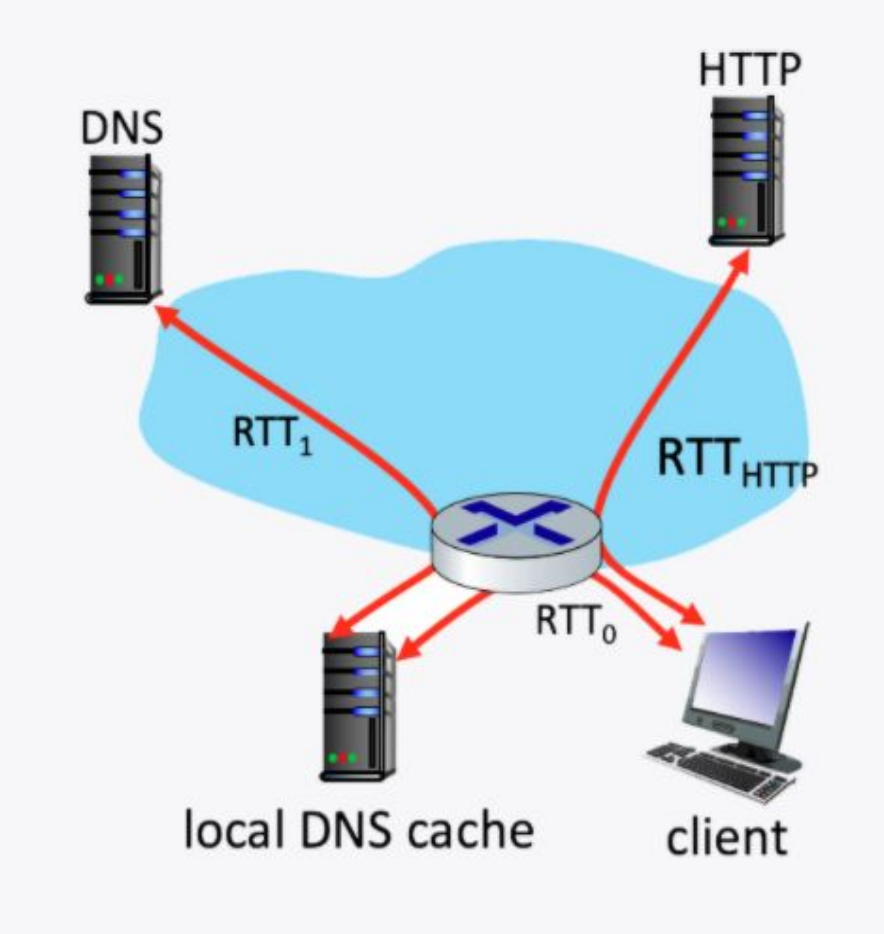
c. What is the transmission delay of link 2?

d. What is the total delay of link 2?

e. What is the transmission delay of link 3?

2. Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that two DNS servers are visited before your host receives the IP address from DNS. The first DNS server visited is the local DNS cache, with an RTT delay of RTT_0 = 4 msecs. The second DNS server contacted has an RTT of 31 msecs. Initially, let's suppose that the Web page associated with the link contains exactly one object, consisting of a small amount of HTML text. Suppose the RTT between the local host and the Web server containing the object is RTT_{HTTP} = 94 msecs.

(2 x 5 = 10 Marks)



a. Assuming zero transmission time for the HTML object, how much time (in msec) elapses from when the client clicks on the link until the client receives the object?
b. Now suppose the HTML object references 6 very small objects on the same server. Neglecting transmission times, how much time (in msec) elapses from when the client clicks on the link until the base object and all 6 additional objects are received from web server at the client, assuming non-persistent HTTP and no parallel TCP connections?
c. Suppose the HTML object references 6 very small objects on the same server, but assume that the client is configured to support a maximum of 5 parallel TCP connections, with non-persistent HTTP.
d. Suppose the HTML object references 6 very small objects on the same server, but assume that the client is configured to support a maximum of 5 parallel TCP connections, with persistent HTTP.
e. What's the fastest method we've explored: Nonpersistent-serial, Nonpersistent-parallel, or Persistent-parallel?

3. Consider a network connecting two systems located 4000 kilometres apart. The bandwidth of the network is 64 Mbps. The propagation speed of the media is 2/3 of the speed of light in vacuum. It is needed to design selective repeat sliding window protocol for this network. The average packet size is of 8 KB. The network is to be used to its full capacity. Assume that processing delays at nodes are negligible. Then, what will be the minimum size of the sequence number field (in bits). **(3 Marks)**

4. Consider a wireless link, where the probability of packet error is 0.6. To transfer data across the links, Stop and Wait protocol is used. The channel condition is assumed to be independent from transmission to transmission. The average number of transmission attempts required to transfer x packets is 500. Find the value of x. **(3 Marks)**

5. Suppose host A is sending a large file to host B over a TCP connection. The two end hosts are 10msec apart (20msecRTT) connected by a 1Gbps link. Assume that they are using a packet size of 1000 bytes to transmit the file. Also assume for simplicity that ACK packets are extremely small and can be ignored. **(2 x 2 = 4 Marks)**

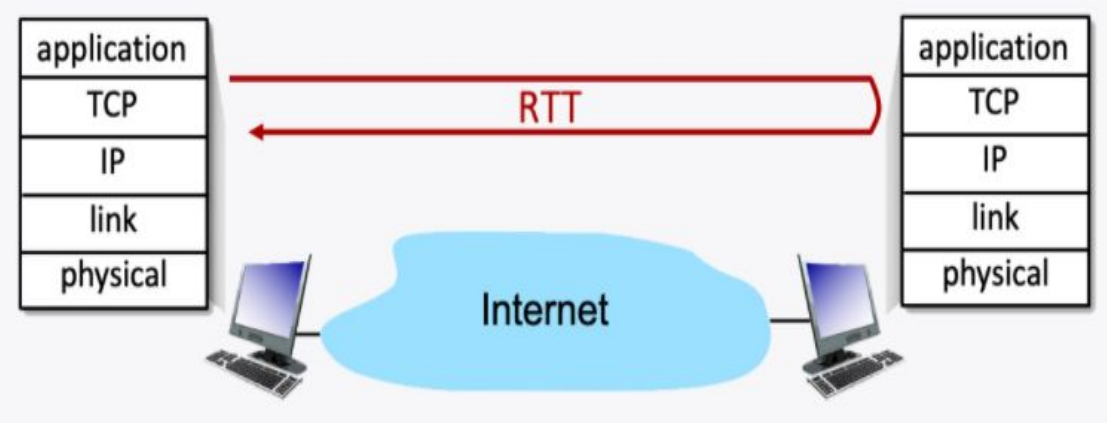
a. At least how big would the window size (in packets) have to be for the channel utilization to be greater than 80%.
b. Assuming infinite initial threshold, no losses and competing traffic, approximately how long (in seconds) would it take for the normal slow start mechanism to achieve 80% utilization?

6. The value of HLEN in an IPv4 datagram is 7. How many option bytes are present? **(3 Marks)**

7. Suppose that TCP's current estimated values for the round trip time (*estimatedRTT*) and deviation in the RTT (*DevRTT*) are 330 msec and 11 msec, respectively (see Section 3.5.3 for a discussion of these variables). Suppose that the next three measured values of the RTT are 320 msec, 360 msec, and 300 msec respectively.

Compute TCP's new value of *DevRTT, estimatedRTT,* and the TCP timeout value after each of these three measured RTT values is obtained. Use the values of $\alpha = 0.125$, and $\beta = 0.25$. Round your answers to two decimal places after leading zeros.

(1 x 7 = 7 Marks)



a. What is the estimatedRTT after the first RTT?

b. What is the RTT Deviation for the the first RTT?

c. What is the TCP timeout for the first RTT?

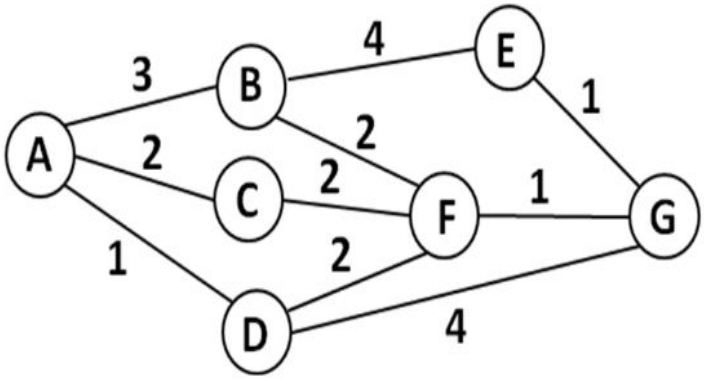
d. What is the estimatedRTT after the second RTT?

e. What is the RTT Deviation for the the second RTT?

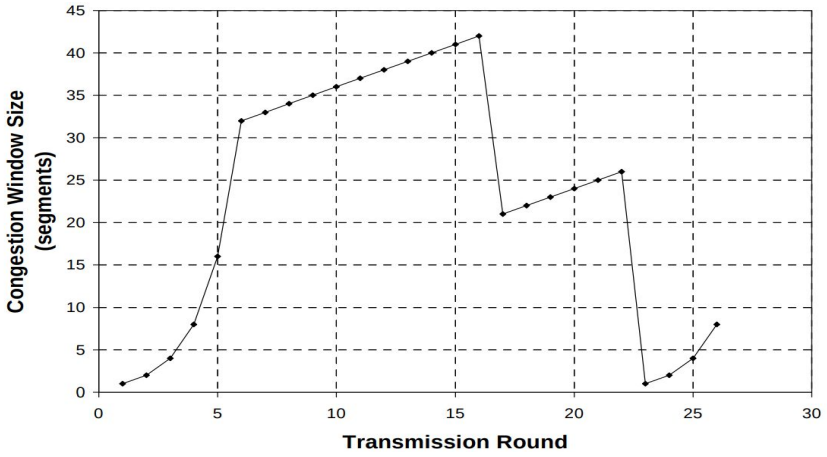
f. What is the TCP timeout for the second RTT?

g. What is the estimatedRTT after the third RTT?

8. The network shown in Figure uses a Link State Routing protocol. Construct a Shortest Path Tree for node A, using Dijkstra's algorithm, show the steps. **(3 Marks)**



9. Assuming TCP Reno is the protocol experiencing the behavior shown below in the Figure, answer the following questions. **(3 Marks)**



TCP window size as a function of time

a. Identify the intervals of time when TCP slow start is operating.
b. During what transmission round is the 24th segment sent?
c. Assuming a packet loss is detected after the 26th round by the receipt of a triple duplicate ACK, what will be the values of the congestion window size and of ssthreshold?

10. True/False Questions: **(4 Marks)**

a. Suppose Host A is sending Host B a large file over a TCP connection. The number of unacknowledged bytes that A sends cannot exceed the size of the receive buffer.
b. Suppose Host A is sending a large file to Host B over a TCP connection. If the sequence number for a segment of this connection is m, then the sequence number for the subsequent segment will necessarily be m + 1.
c. Suppose that the last Sample RTT in a TCP connection is equal to 1 sec. The current value of Timeout Interval for the connection will necessarily be ≥ 1 sec.
d. Suppose Host A sends one segment with sequence number 38 and 4 bytes of data over a TCP connection to Host B. In this same segment the acknowledgment number is necessarily 42.

11. Write the IP address 222.1.1.20 mask 255.255.255.192 in CIDR (Classless Inter-Domain Routing) notation. **(2 Marks)**

12. You have been allocated a class C network address of 211.1.1.0 and are using the default subnet mask of 255.255.255.0 how many hosts can you have? **(2 Marks)**

13. Subnet the Class C IP Address 195.1.1.0 So that you have at least 2 subnets each subnet must have room for 48 hosts. What are the two possible subnet masks? **(3 Marks)**

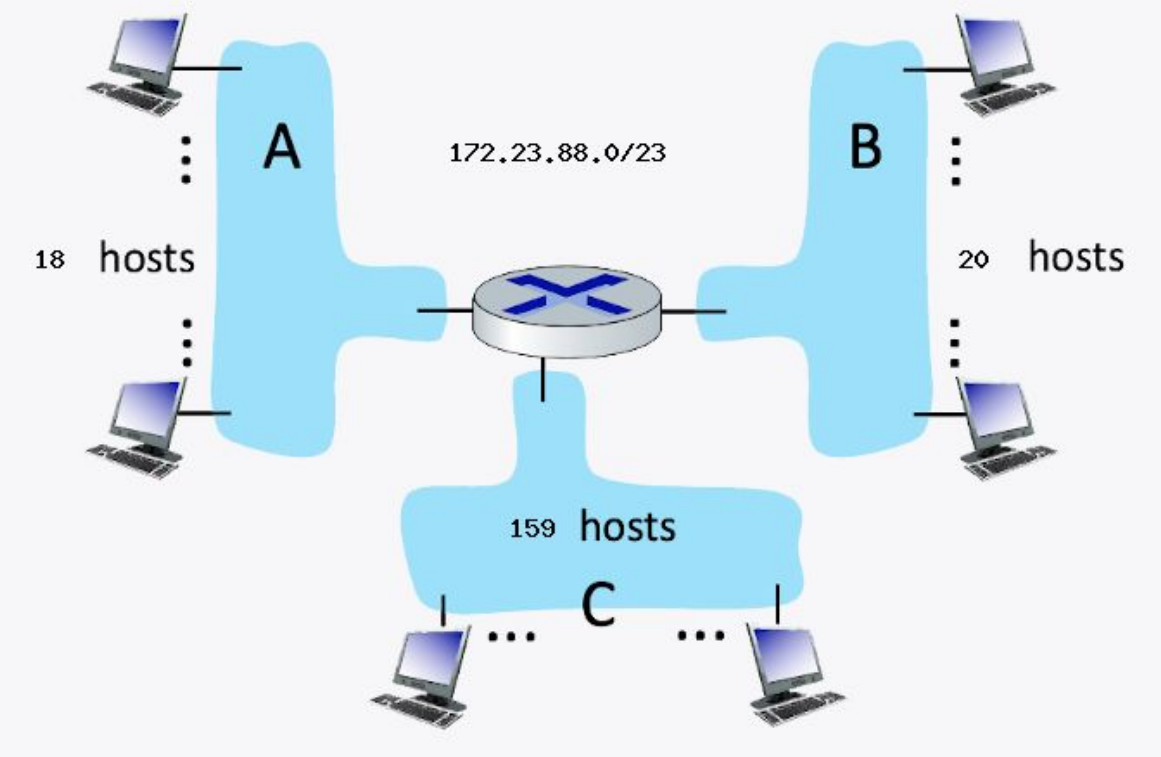
14. Given the subnet Mask 255.255.255.192. What is the host address and subnet of the following IP address 197.1.2.67. **(3 Marks)**

15. Consider a datagram network using 8-bit host addresses. Suppose a router uses longest-prefix matching, and has the following forwarding table: **(1 x 3 = 3 Marks)**

Prefix Match	Interface
01	1
00	2
011	3
001	4
110	5
otherwise	6

a. Suppose a datagram arrives at the router, with destination address 00100000. To which interface will this datagram be forwarded using longest-prefix matching?
b. Suppose a datagram arrives at the router, with destination address 11001100. To which interface will this datagram be forwarded using longest-prefix matching?
c. Suppose a datagram arrives at the router, with destination address 01101110. To which interface will this datagram be forwarded using longest-prefix matching?

16. Consider the router and the three attached subnets below (A, B, and C). The number of hosts is also shown below. The subnets share the 23 high-order bits of the address space: 172.23.88.0/23. **(1 x 7 = 7 Marks)**



Assign subnet addresses to each of the subnets (A, B, and C) so that the amount of address space assigned is minimal, and at the same time leaving the largest possible contiguous address space available for assignment if a new subnet were to be added. Then answer the questions below.

a. Is the address space public or private?
b. How many hosts can there be in this address space?
c. What is the subnet address of subnet A? (CIDR notation)
d. What is the broadcast address of subnet A?
e. What is the starting address of subnet A?
f. What is the ending address of subnet A?
g. What is the subnet address of subnet B? (CIDR notation)