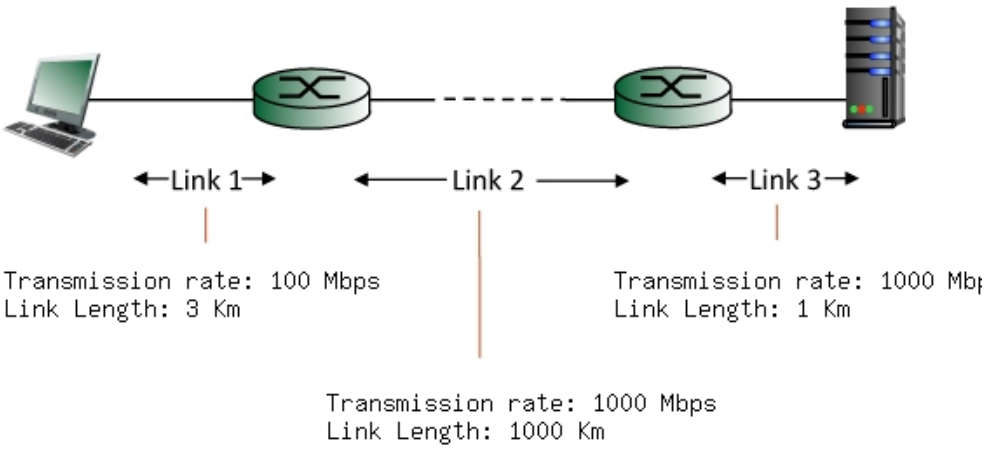
Networking Questions

January 31, 2022

Question	Points	Score
1	3	
2	3	
3	2	
4	3	
5	5	
6	2	
7	1	
8	3	
9	10	
10	5	
11	2	
12	3	
Total:	42	

1. (3 points) How does HTTP detect the end of a request? How does IPv4 detect the end of a packet? Why are they different?

2. (3 points) Find the end-to-end delay (including the transmission delays and propagation delays on each of the three links, but ignoring queueing delays and processing delays) from when the left host begins transmitting the first bit of a packet to the time when the last bit of that packet is received at the server at the right. The speed of light propagation delay on each link is 3×10^8 m/s. Note that the transmission rates are in Mbps and the link distances are in Km. Assume a packet length of 4000 bits. Give your answer in milliseconds.



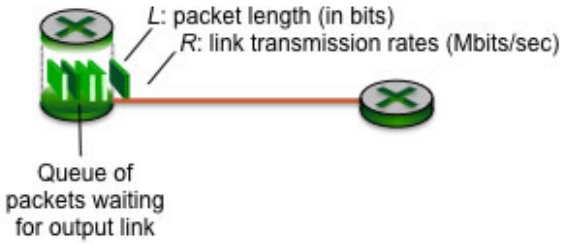
(a) Link 1 Delay

(b) Link 2 Delay

(c) Link 3 Delay

(d) Total Delay

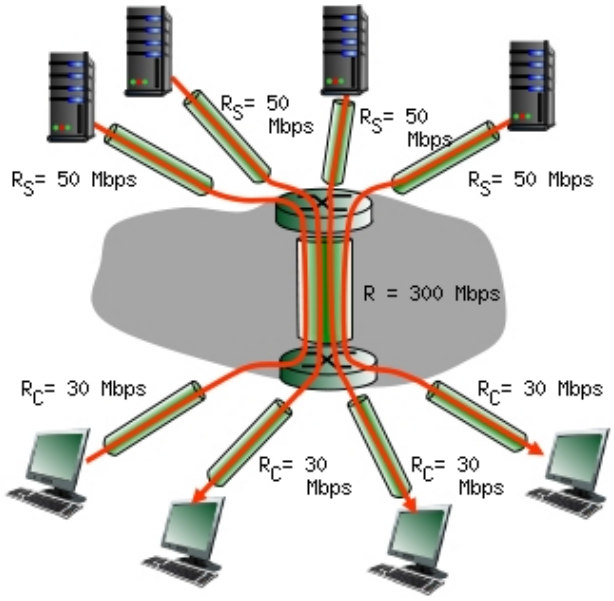
3. (2 points) Suppose that the packet length is L = 5 KB, and that the link transmission rate along the link to router on the right is R = 1 Mbps. Assume that 1 KB = 1000 bytes.



(a) What is the transmission delay (the time needed to transmit all of a packet's bits into the link)?

(b) What is the maximum number of packets per second that can be transmitted by the link?

4. (3 points) Consider the scenario shown above, with four different servers connected to four different clients over four three-hop paths. The four pairs share a common middle hop with a transmission capacity of R = 300 Mbps. The four links from the servers to the shared link have a transmission capacity of R_S = 50 Mbps. Each of the four links from the shared middle link to a client has a transmission capacity of R_C = 30 Mbps per second.



(a) What is the maximum achievable end-to-end throughput (in Mbps) for each of four client-to-server pairs, assuming that the middle link is fair-shared (i.e., divides its transmission rate equally among the four pairs)?

(b) Which link is the bottleneck link for each session?

(c) Assuming that the senders are sending at the maximum rate possible, what are the link utilizations for the sender links (R_S), client links (R_C), and the middle link (R)?

5. (5 points) Using the following HTTP GET message, answer the following questions:

```
GET /526/hw1/answers.txt HTTP/1.1
Host: ecenetworking.byu.edu
User Agent: Mozilla/5.0 (Windows NT 5.1; rv:11.0) Gecko/20100101 Firefox/11.0
```

   (a) What is the name of the file that is being retrieved in this GET message?

   (b) What version of HTTP is the client running?

   (c) Assuming this request came from a web browser, what was the full URL that was typed into the address bar?

   (d) What browser and operating system did this request come from?

   (e) Assuming that the file does not exist, write out the HTTP response? You do not need to include any extra headers.

6. (2 points) What does fairness mean in the context of TCP? What feature of TCP makes it fair? How?

7. (1 point) How does TCP detect duplicate data?

8. (3 points) Consider UDP and TCP.

   (a) List the guarantees UDP provides (hint: there is at least one).

   (b) List the guarantees of TCP (hint: there is at least four).

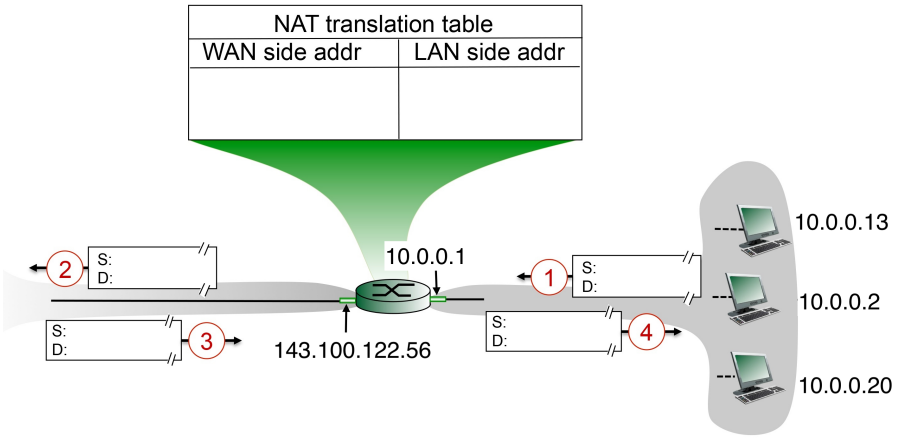
   (c) Why would someone use UDP over TCP?

9. (10 points) HTTP is a text-based protocol, meaning that data is sent in plain text, rather than binary-encoded data. Design a binary-encoded version of an HTTP request. Look at the TCP and IP packet structures for inspiration. List each field, the size of each field (in bytes or bits), and a brief description of the field. The description should include a justification for the size of the field and any limitations that were introduced. For example, an HTTP request must include a version:

Field Name	**Field Size**	**Field Description**
Version	4 bits	The HTTP version. 4 bits can represent 16 values. This can represent current versions and most likely all future versions of HTTP. Version 1.0 corresponds to the binary value 0, 1.1 corresponds to the binary value 1, and 2.0 corresponds to the binary value 2.
...	...	...

Your protocol should be able to accommodate variable size file names, variable header values, and variable payloads.

10. (5 points) Consider the scenario below in which three hosts, with private IP addresses 10.0.0.13, 10.0.0.2, 10.0.0.20 are in a local network behind a NATed router that sits between these three hosts and the larger Internet. IP datagrams being sent from, or destined to, these three hosts must pass through this NAT router. The router's interface on the LAN side has IP address 10.0.0.1, while the router's address on the Internet side has IP address 143.100.122.56. Suppose that the host with IP address 10.0.0.20 sends an IP datagram destined to host 128.119.161.189. The source port is 3451, and the destination port is 80.



(a) Consider the datagram at step 1, after it has been sent by the host but before it has reached the NATted router. What are the source and destination IP addresses for this datagram? What are the source and destination port numbers for the TCP segment in this IP datagram?

(b) Now consider the datagram at step 2, after it has been transmitted by the NATted router. What are the source and destination IP addresses for this datagram? What are the source and destination port numbers for the TCP segment in this IP datagram? Specify the entry that has been made in the router's NAT table.

(c) Now consider the datagram at step 3, just before it is received by the NATted router. What are the source and destination IP addresses for this datagram? What are the source and destination port numbers for the TCP segment in this IP datagram?

(d) Last, consider the datagram at step 4, after it has been transmitted by the NATted router but before it has been received by the host. What are the source and destination IP address for this datagram? What are the source and destination port numbers for the TCP segment in this IP datagram?

11. (2 points) What are the congestion window (`cwnd`) and and receive window (`rwnd`) used for in TCP?

12. (3 points) What are the pros and cons of the following multiple access protocols?

    (a) Channel Partitioning

    (b) Random Access

    (c) Taking Turns