ECE/CSC570: Computer Networks

Spring 2020

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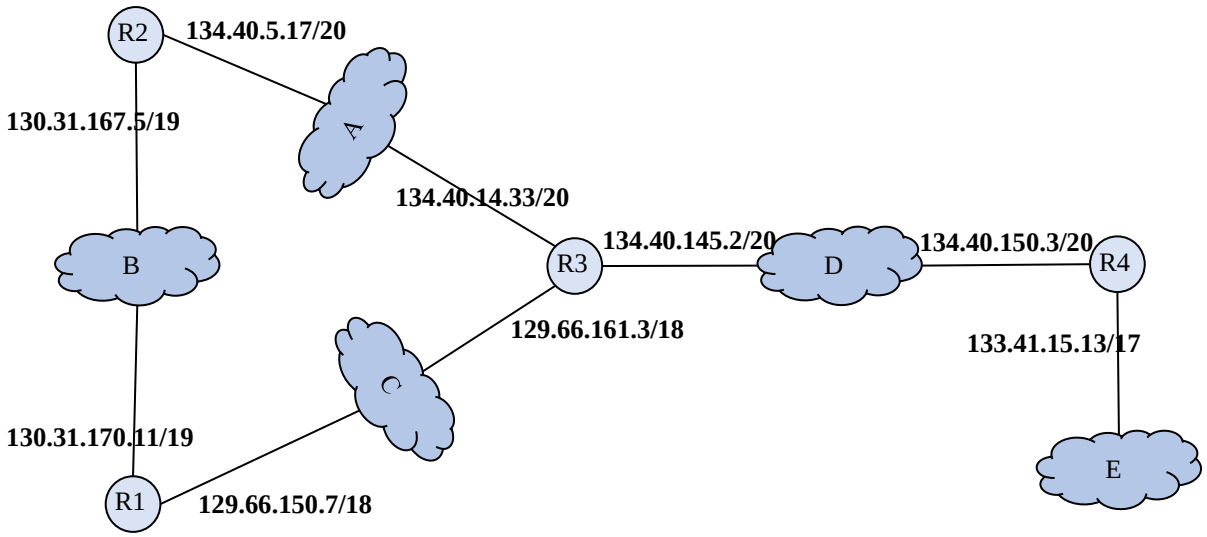
Homework 5

Due: 11:59 pm, Wednesday, April 22, 2020

1. Network Layer-I (15 points)

Consider the following enterprise inter-network which uses **Classless InterDomain Routing (CIDR)** addresses.



a. (5p) How many subnets are there in the above inter-network? What are their subnet masks?

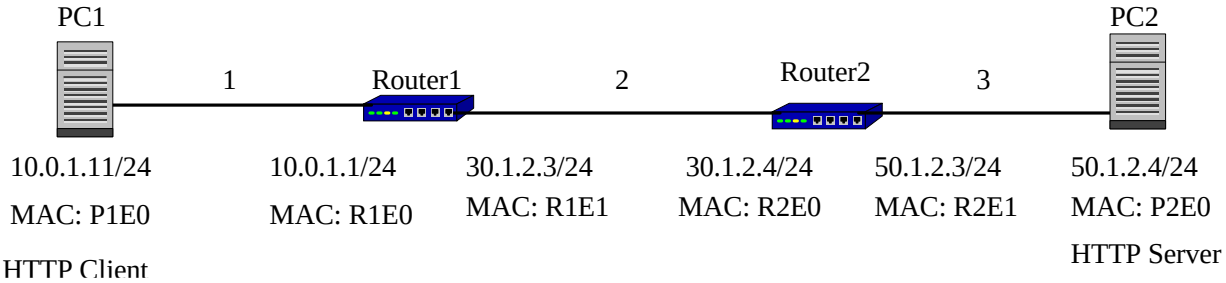
Subnet ID	Subnet Mask

b. (5p) Consider two hosts H1 and H2 configured with addresses 134.40.12.125 and 134.40.145.100, respectively. Which network, if any, can they be placed among A, B, C, D, or E?

c. (5p) Fill up the routing table at router R3. Remember that you have to provide one routing table entry for each subnet.

Destination Address	Next Hop Address

2. Network Layer-II (15 points)



Consider the network topology shown in the figure above. PC1 is an *HTTP client* accessing an HTML page on the *HTTP server* on PC2. Router 1 runs a **Network address port translation (NAPT)** to convert from the private address space behind it (i.e., left-hand side) to the public addresses outside (i.e., right-hand side). List the **MAC** and **IP addresses** as well as **port numbers** of a TCP packet exchange between the two PCs. Fill in the table below:

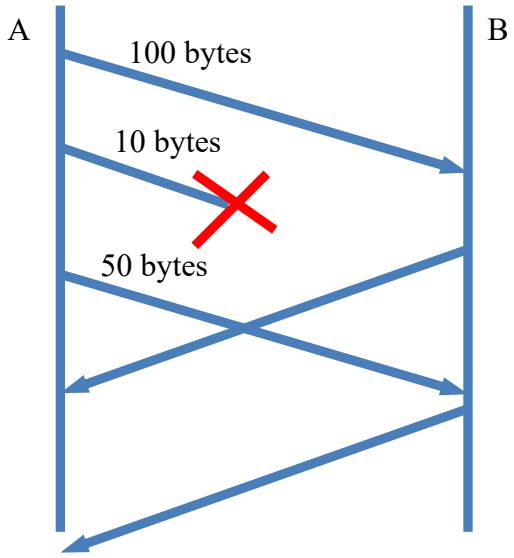
Link	Src. MAC	Dst. MAC	Src. IP	Dst. IP	Src. Port	Dst. Port	Type
1	P1E0	R1E0	10.0.1.11	50.1.2.4	2000	80	TCP SYN
2	R1E1	R2E0	30.1.2.3	50.1.2.4	3333	80	TCP SYN
3							TCP SYN
3							TCP SYN ACK
2							TCP SYN ACK
1							TCP SYN ACK

3. Transport Layer-I (30 points)

a. (5p) Suppose that a TCP source uses α=0.2. Further assume that this TCP source has just received four ACKs for which it calculated the following SampleRTT values: 55ms, 60ms, 50ms, 45ms. What is the latest EstimatedRTT value at this TCP source? Assume that the starting value of EstimatedRTT is 0.

b. (5p) What parameters must be defined in order to uniquely identify a socket? Give your answer for TCP and UDP separately.

c. (15p) Suppose Host A sends three TCP segments back to back to Host B over a TCP connection. The amounts of data in these three segments are 100 bytes, 10 bytes, and 50 bytes from the first to the third segment respectively. Assume that the first segment's sequence number (i.e., the sequence number of the first byte in the first segment) is 20. Suppose the second segment is lost but the other two segments arrive at B. Further assume that ACKs arrive safely back to A. The scenario is sketched below.



i. (5p) What are the sequence numbers of the second and the third segments?

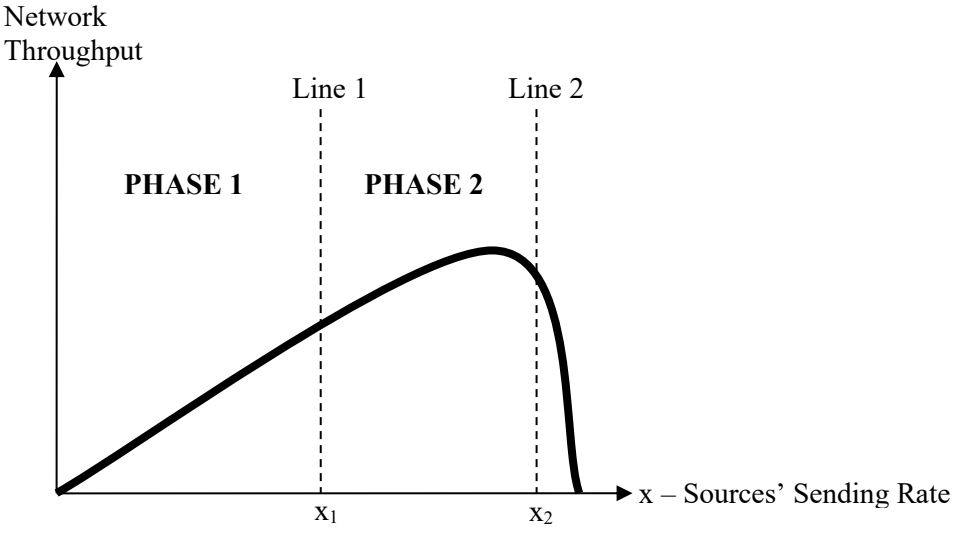
ii. (5p) What will be the ACK numbers that Host B sends to Host A?

iii. (5p) Suppose the TCP reliability algorithm is using selective acknowledgments (i.e. TCP SACK). What will be the ACK (or NACK) numbers that Host B sends to Host A? Briefly explain.

d. (5p) Write one advantage and one disadvantage for connection-oriented and connectionless transport services.

4. Transport Layer-II (30 points)

a. (13p) TCP congestion control algorithm operates in two different phases. The following graph shows the regions where these two phases take place. The graph plots throughput experienced by all TCP flows in the network versus TCP sources' sending rate. Please answer the following questions based on this graph.

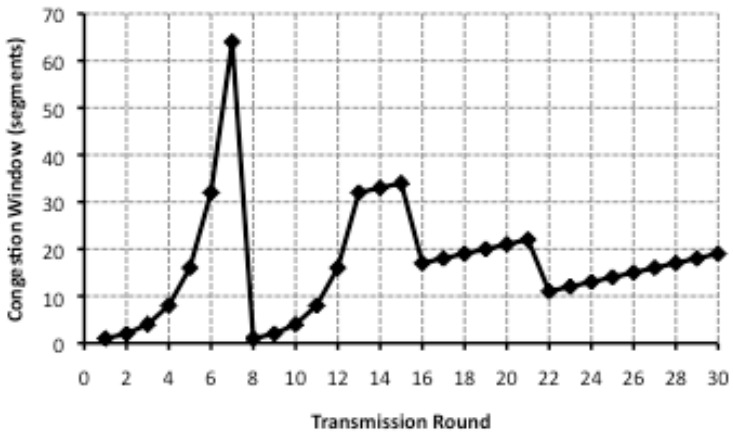


i. (4p) What are the names of Phase 1 and Phase 2?

ii. (4p) What is the name of the region at the right of Line 2 (i.e., $x > x_2$)? Why is the throughput making a sharp decline in that region? Be brief.

iii. (5p) What mechanisms TCP uses to detect the placement of Line 1 and Line 2 (i.e., x_1 and x_2)?

b. (11p) Consider the following chart that shows the congestion window size of a TCP sender in different transmission rounds during a TCP connection. Answer the following questions assuming that the TCP protocol version is **TCP Reno**.



i. (2p) After the 15th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?

ii. (2p) After the 7th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?

iii. (3p) What is the value of Threshold at the 18th transmission round?

iv. (4p) Is it possible to determine the initial value of Threshold at the first transmission round? If so, what is it? Explain.

c. (6p) During what transmission round is the 200th segment sent? Count the segments ignoring the fact that there might be retransmissions.

5. Security (10 points)

a. (4p) Consider an RSA cryptosystem with parameters p=17, q=19, and e=5. What is ciphertext c for plaintex message m=10? Show your steps.

b. (2p) In the RSA algorithm, what is the security flaw with choosing e=1 for the public key?

c. (4p) Compared to the symmetric key designs, what are the advantages and disadvantages of the public-key design?