CS 349/449
Internet Protocols
Midterm Exam
Winter 2003

10/21/2003

Question	349 Points	449 Points	Score
1	10	10	
2	20	10	
3	20	20	
4	20	20	
5	30	20	
6 (449 only)	-	20	
Total:	100	100	

Name:_____

Instructions:

1. You have 1 hour to finish
1. Question 6 is **only** for 449 students
1. Closed books, closed notes. Write all your answers using the pages on this exam (use back pages if needed)

- Calculators allowed
- This exam has 8 pages, including this cover page

Question 1

Answer the following True/False. You do not need to explain your answers

1. The only enhancement UDP provides over IP is that it multiplexes and de-multiplexes packets for the processes **TRUE**

1. Go-Back-N discards out of order packets at the receiver, while Selective Repeat buffers them **FALSE**

1. The "receive window" header in TCP is used for congestion control **FALSE**

1. Opening a TCP connection requires 2 messages **FALSE**

1. IP provides reliable delivery service **FALSE**

1. Ethernet uses the CSMA/CD MAC protocol **TRUE**

1. IP fragments are reassembled at intermediate hops **FALSE**

1. IP checksum covers the whole packet **FALSE**

1. All packet of a TCP connection follow the same path between source and destination **FALSE**

1. BGP is an intra-domain routing protocol **FALSE**

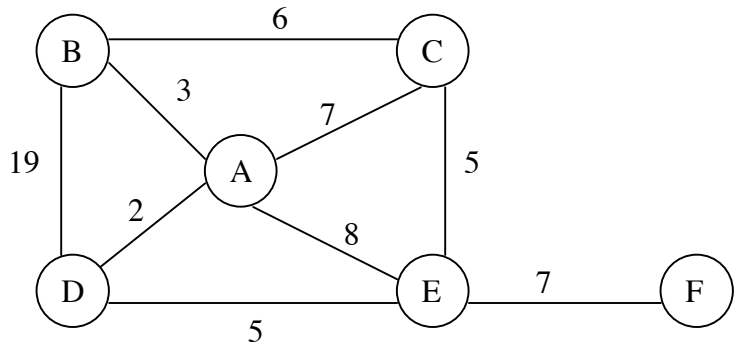
Question 2: A client C, and a server S are interconnected by a series of N store-and-forward routers. Every link operates at B bits per second and has a propagation delay of T seconds. After receiving each packet, it takes a router at least L seconds to process the packets before starting to transmit again. All packets are P bits long.

Write down an expression for the time taken from which the first bit of the first packet leaves the server until the last bit of the 10^{th} packet reaches the client. Assume there is no gap between packets sent by the server

Answer: The first packet will be delivered to the client after (N+1)*(P/B+T)+L*N seconds. After that one additional packet arrives at the client every P/B seconds. Thus the total time needed for all 10 packets to be transmitted is

(N+1)*(P/B+T) + L*N + 9*P/B

Question 3: Assume that each router starts with a cost of infinity to reach any other router (other than it's immediate neighbors). Use a sequence of tables (one table for each time the routers exchange their routing tables), to show how each router learns the next hop and the cost to reach router F.



Answer:

Let's assume that routers exchange their tables every R seconds

i) T = 0

Nodes A, B, C, D

Dest	**Nhop**	**Dist**
F	-	Inf

Node E

Dest	**Nhop**	**Dist**
F	F	7

ii) T = R

Node A

Dest	**Nhop**	**Dist**
F	E	15

Node D

Dest	Nhop	Dist
F	E	12

Node C

Dest	Nhop	Dist
F	E	12

Node B

Dest	Nhop	Dist
F	-	Inf

iii) T = 2R

Node A

Dest	Nhop	Dist
F	D	14

Node B

Dest	Nhop	Dist
F	A	18

Node C

Dest	Nhop	Dist
F	E	12

Node D

Dest	Nhop	Dist
F	E	12

iv) T = 3R

Node B

Dest	Nhop	Dist
F	17	A

Question 4: Assuming that the link state information has been correctly received by all routers, show how the router F determines the lower cost path to reach all the other routers in the network. At each stage, be sure to show the candidate set, the shortest path set S and the cost of each path in the tree.

Step	**S**	**D(A),p(A)**	**D(B),p(B)**	**D(C),p(C)**	**D(D),p(D)**	**D(E),P(E)**
0	F	Inf	Inf	Inf	Inf	7,F
1	F,E	15,E	Inf	12,E	12,E	7,F
2	F,E,C	15,E	18,C	12,E	12,E	7,F
3	F,E,C,D	14,D	18,C	12,E	12,E	7,F
4	F,E,C,D,A	14,D	17,A	12,E	12,E	7,F
5	F,E,C,D,A,B	14,D	17,A	12,E	12,E	7,F

Question 5: Suppose a client in host A downloads a file from a web server in host B using a reliable delivery protocol. How long does it take to complete the transmission when the following conditions are imposed?

- The Transmission rate is 10 Mbps
- Node A is separated from Node B by 2000 miles on a single link
- The propagation delay is 10 microsec/mile
- The file is 36000 bytes
- The transmission time for ACKs is negligible
- The maximum segment size is 1500 bytes
- Assume that the standard IP +TCP headers are sent

a. Assume that the reliable protocol used between A and B is Send and Wait

Answer: The total number of segments that have to be sent is 36000/1500 = 24. Propagation time is P=10microsec/mile*2000miles = 20msec, Transmission time for a single segment is T=1540*8/10*10^6 = 1.2msec.
Each round (sending a segment until the acknowledgement comes back) is equal to 2P+T=41.2msec. We have 24 rounds to send all the data for a total of 24*41.2 = 988.8 msec

b. Assume that the reliable protocol used between A and B is Go-Back-N with a window of 10 maximum size segments.

Answer: In the first two rounds 20 segments will be sent. The time required until the acknowledgement for the 24^{th} segment makes it back to the sender is 2*P+4*T=44.8. Therefore the total time required to send the 24 segments is

2*41.2+44.8 = 127.2

Question 6: (CS449 Only)
Let A be the number of autonomous systems on the Internet, and let D (for diameter) be the maximum AS path length.

(a) Give a connectivity model for which D is of order logA and another for which D is of order square root of A

Answer: A binary tree has D of 2logA while a square has diameter square root of A

(b) Assuming each AS number is 2 bytes and each network number is 4 bytes, give an estimate of the amount of data a BGP speaker must receive to keep track of the AS path to every network. Express your answer in terms of A, D and the number of networks N.

Answer: Assume that the networks are evenly distributed among the A autonomous systems. Since the AS path length is O(D) the total amount of data a BGP speaker must receive is equal to **2*D*4*N** bytes. If we assume that perfect aggregate is possible, so all the networks advertised by an AS can be aggregated to a single prefix, then the amount of data a BGP speaker needs to receive reduces to **2*D*4*N/A** bytes