ECE/CSC570: Computer Networks

Spring 2020

Prof. Shih-Chun Lin

Homework 4

Due: 11:59 pm, Thursday, April 9th, 2020

1. Link Utilization (10 points)

Compute the efficiency of **stop and wait** (**SAW**) and of a **pipelined protocol** (e.g. **Go-Back-N**) with a window size of **five** packets.

- Assume that there are no packet losses.
- Assume that the transmission time of the packets is 5ms and ignore the transmission time of the acknowledgments (it's too small to matter for this problem).
- The propagation delay (one way) is 200 msec.

2. ALOHA (20 points)

a. A group of *N* stations share a 56-kbps pure ALOHA channel. Each station outputs a 1000-bit frame on average once every 100 sec, even if the previous one has not yet been sent (e.g., the stations can buffer outgoing frames). What is the maximum value of *N*?

b. A large population of slotted ALOHA users manages to generate 50 requests/sec, including both originals and retransmissions. Time is slotted in units of 40 msec.

i. What is the chance of success on the first attempt?
ii. What is the probability of exactly *k* collisions and then a success?
iii. What is the expected number of transmission attempts needed?

3. CSMA/CD (20 points)

a. What is the length of a contention slot in CSMA/CD for

i. a 2-km twin-lead cable, whose signal propagation speed is 82% of the signal propagation speed of light in vacuum?
ii. a 40-km multimode fiber optic cable, whose signal propagation speed is 65% of the signal propagation speed of light in vacuum?

b. Two CSMA/CD stations are each trying to transmit long files (i.e., multiple frames are waiting to be sent). After each frame is sent, they contend for the channel, using the *binary exponential backoff algorithm*. What is the probability that the contention ends on round *k*? What is the mean number of rounds per contention period?
Hint: Consider the geometric distribution.

4. Interconnecting Networks (10 points)

Regarding the interconnecting network devices, what is the difference between **LAN switches** and **routers**?

5. Shortest Path Routing (20 points)

Find the shortest path from node F to all other nodes in the network shown by using the Dijkstra shortest path algorithm. That is, show how the algorithm works by filling the tables below.

- Assume that all links are bidirectional with the same weight in both directions.
- D(X) represents the best-known distance to node X.
- nh(X) represents the node next to last hop on the path from source F to destination X. For example, if the route from F to A is F-D-B-A, then nh(A)=B.

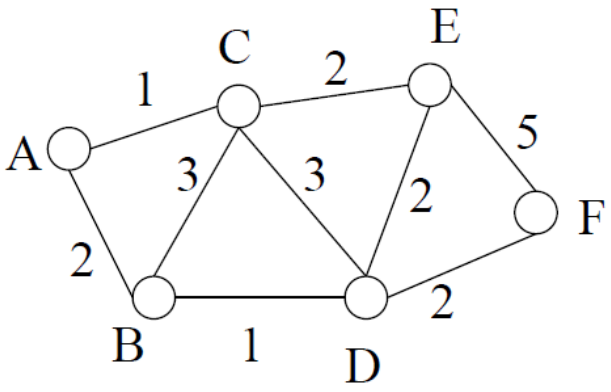

TABLE 1:

Step	Black nodes	D(A),nh(A)	D(B),nh(B)	D(C),nh(C)	D(D),nh(D)	D(E),nh(E)
0	F	∞	∞	∞	2,F	5,F
1						
2						
3						
4						
5						
6						

TABLE 2 Routing table:

Destination	Next Hop	Cost
A		
B		
C		
D		
E		

6. Distance Vector Routing (20 points)

Assume that router A running a distance vector routing protocol and receives the following update from its two neighbors B and C:

B's routing table:

Destination	Distance
A	2
B	-
C	5
D	7
F	1
G	4

C's routing table:

Destination	Distance
A	4
B	5
C	-
D	2
F	2
G	3

Assume that the link weights are symmetrical (i.e., the weight of the link A-B is the same as of the link B-A), fill in A's resulting routing table.

A's routing table:

Destination	Distance	Next Hop
B		
C		
D		
F		
G		