Introduction to Computer Networks (S12) June 20 2013

- Please put your name and student ID on your answer sheets.
- Total score: 100 points
- Final exam time: 2:20-5:30pm
- Please turn in your answer sheets together with your exam sheet when you are done.

1. (15%, 5 points each) Networking Basis

   (a) Please determine the CRC code for data message 101100011011 with Generator 1001.

   (b) Determine which of the following IPv6 address notations are correct:

   (i) ::0F53:6382:AB00:67DB:BB27:7332

   (ii) 7803:42F2:::88EC:D4BA:B75D:11CD

   (iii) ::4BA8:95CC::DB97:4EAB

   (iv) 74DC::02BA

   (v) ::00FF:128.112.92.116

   (c) Can the poisoned reversed solve the general count-to-infinity problem? Please justify your answer.

2. (30%, 15 points each) Routing algorithms

   (a) Consider the network shown in Fig. 1. Please give 1) the least number of iterations required before the distributed algorithm converges, and 2) give the forwarding table of node A (indicating destination, next hop, and cost for each entry), based on a synchronous version of the distance-vector algorithm. Please do show how you determine to indicate your answer. You must show the "next hop" and "distance-vector estimate" of each node for every iteration (i.e., A[(A,0), (B,1), (C,2), (D,3), (E,4)]).

   (b) Please show how the link-state algorithm determines the forwarding table for node A in the network shown in Fig. 1.

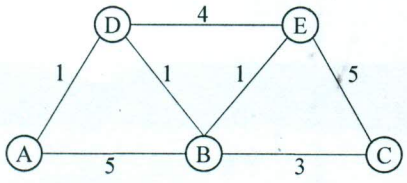

Fig. 1: Network topology for Prob. 2

A

Node	Cost	Next Hop
B	1	B
C	1	C
D	2	B
E	3	C
F	2	C

F

Node	Cost	Next Hop
A	2	C
B	3	C
C	1	C
D	2	C
E	1	E

Fig. 2: Forwarding tables of nodes A and F for Prob. 3

3. (25%) IP routing and forwarding

   (a) (10%) Suppose we have the following forwarding tables shown in Fig. 2 for nodes A and F; in a network where all links have cost 1. Give a topology of the smallest network consistent with these tables.

   (b) (15%) Suppose a TCP message that contains 1024 bytes of data and 20 bytes of TCP header is passed to IP for delivery across several subnets (i.e., from source host connected to router A to destination host connected to router F) in the network you determined for Prob. 3(a). Assume all IP headers are 20 bytes. The source subnet has a maximum frame size of 1024 bytes including a 14-byte header; the destination subnet has a maximum frame size of 576 bytes including an 8-byte header; the rest of the subnets have a maximum frame size of 512 bytes including a 12-byte header. Please give the fields of *length*, *offset*, and *flags* (*More Fragment* bit only) of

the sequence of fragments delivered to the network layer at the destination host. Note that MTU stands for the maximum transmission unit, which is the maximum amount of data that a link-layer frame can carry. The IP datagram format is shown in Fig. 3.

4. (20%, 10 points each) Suppose there are two active nodes A and B on the same 10Mbps broadcast channel, and the propagation delay between nodes A and B is 312 bit times.
   (a) Suppose the two nodes competing for an access to the channel using slotted ALOHA. Assume each node has an infinite number of frames to send and each node attempts to transmit in each slot with probability p. The first slot is numbered slot 1, the second slot is numbered slot 2, and so on. What is probability that node A succeeds for the first time in slot 5? What is the efficiency of this two-node system?
   (b) Suppose CSMA/CD and Ethernet frames are used for this channel. Suppose node A begins transmitting a frame and before it finishes, node B starts its transmission. Can node A finish transmitting before it detects that node B has transmitted? Why or why not? The format of an Ethernet frame is shown in Fig. 4.

5. (Learning switches; 10%) Consider hosts X, Y, Z, W, and learning switches B_1, B_2, and B_3, with initial empty switch tables, arranged in a way shown in Fig. 5. Give the switch tables (indicating MAC addresses and interfaces, e.g., (MACx, 3)) for all the switches after the following events happen in sequence. For each of the events, identify the links on which the transmitted frame will be forwarded, and also briefly justify your answer.
   - *X* sends to *W*
   - *Z* sends to *X*
   - *Y* sends to *X*
   - *Z* moves to a LAN connected to B_1
   - *Y* moves to a LAN connected to B_1
   - *W* moves to a LAN connected to B_2
   - *Y* sends to *X*
   - *W* sends to *Z*

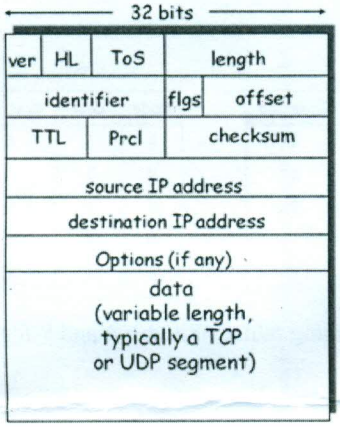

Fig. 3: IP datagram format for Prob. 3

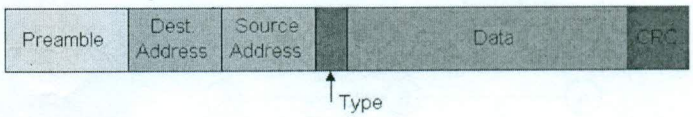

Fig. 4: Ethernet frame format for Prob. 4

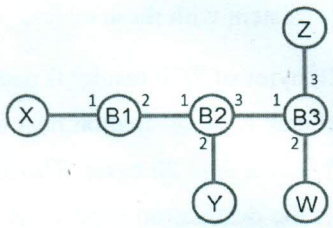

Fig. 5a: Network topology for Prob. 5

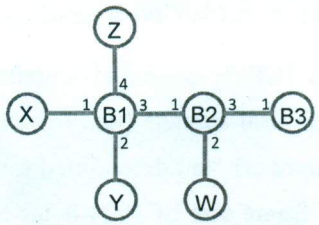

Fig. 5b: Network topology after moving hosts for Prob. 5