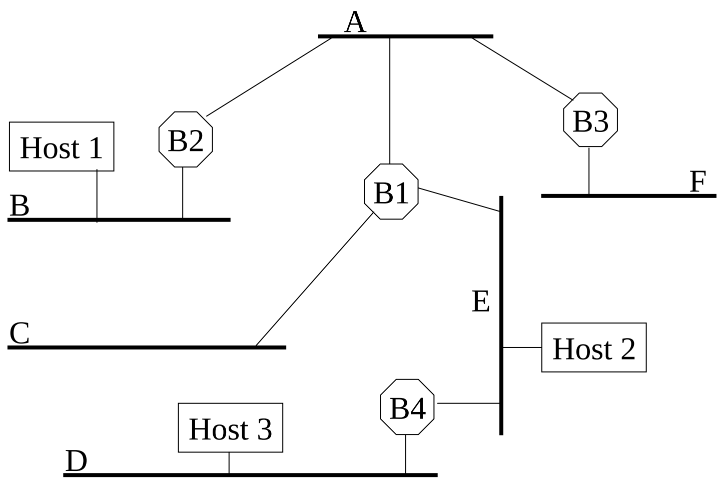
ECE 4380/6380: Computer Communications **Spring 2017**
Problem Set 6 **Due: in class, Friday, March 17**

Assigned reading: Peterson and Davie, Chapter 3. All problems have equal weight.

1. Learning Bridges.

(Hint: review Chapter 3, numbers 15, 16, and 17 for example of similar problems. Solutions to problem 16 are found in the book.)

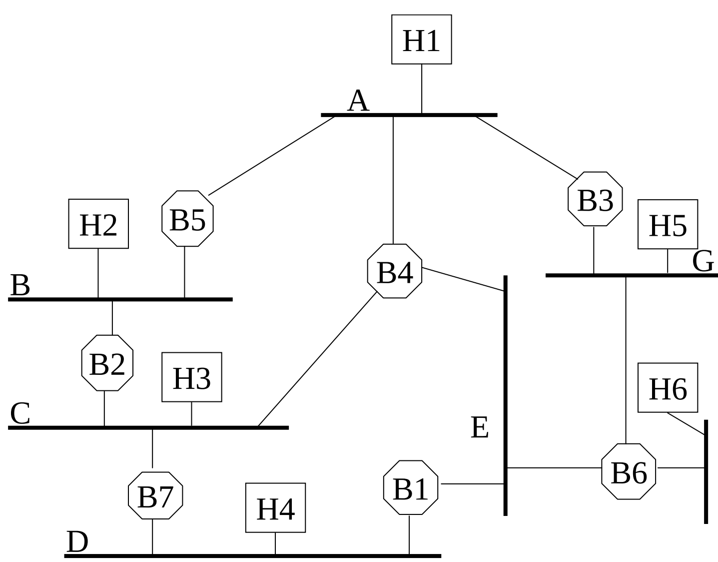
Consider the extended LAN shown at the right, which consists of spanning tree bridges B1, B2, B3, and B4. Note that the bridges form a spanning tree and connect LAN's A, B, C, D, E, and F. Three hosts are connected to the extended LAN: H1, H2, and H3. Initially, assume that there has been no traffic from the hosts for a long period (so that the bridges have cleared their forwarding tables). Assume that all the hosts know the Ethernet addresses for the other hosts.



(a) First, suppose that host H2 sends a message to host H3. List the LAN's on which the packet is transmitted.
(b) Next, suppose that host H3 sends a message to host H2. List the LAN's on which the packet is transmitted.
(c) Next, suppose that host H1 sends a message to host H3. List the LAN's on which the packet is transmitted.

2. Spanning Tree Algorithm for Intelligent Bridges.

Suppose the spanning tree algorithm is used for the network shown to the right. The seven bridges numbered B1 to B7 run the spanning tree algorithm.



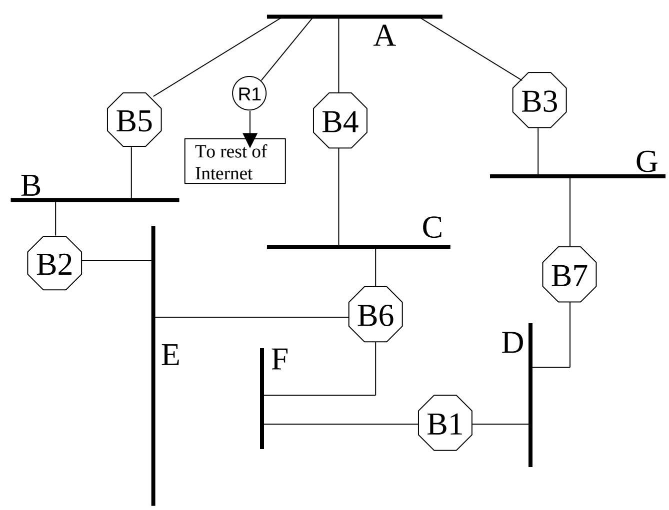
a) Draw a figure of the final spanning tree. Be sure to indicate the root port for each bridge (except the root bridge), the designated port for each LAN, and the links and bridges that do not participate in forwarding data frames.
b) Assume that 6 hosts are attached to the LAN's and shown as H1 to H6 in the figure. Assume that the pair of hosts H1 and H2 will have high levels of traffic for each other. Thus, the spanning tree

should include B5 so that the traffic takes the shortest route possible. Likewise assume H3 and H4 will have a high level of traffic for each other so that the spanning tree should include B7. Finally, host H5 and H6 will also exchange a high level of traffic so that B6 should be included in the tree. Renumber the bridges so that these three bridges are included in the final spanning tree. Draw the resulting spanning tree including the new bridge numbers and root and designated ports. You can only change the numbers assigned to the bridges (e.g., links cannot be moved and no new links can be added).

(Hint: review Chapter 3, numbers 13 and 14 for example of similar problems. The solution to problem 14 is found in the back of the book.)

3. Spanning Tree Algorithm for Intelligent Bridges.

Suppose the spanning tree algorithm is used for the network shown to the right. The seven bridges numbered 1 to 7 run the spanning tree algorithm. Router R1 is connected to LAN A and provides a connection to the Internet.



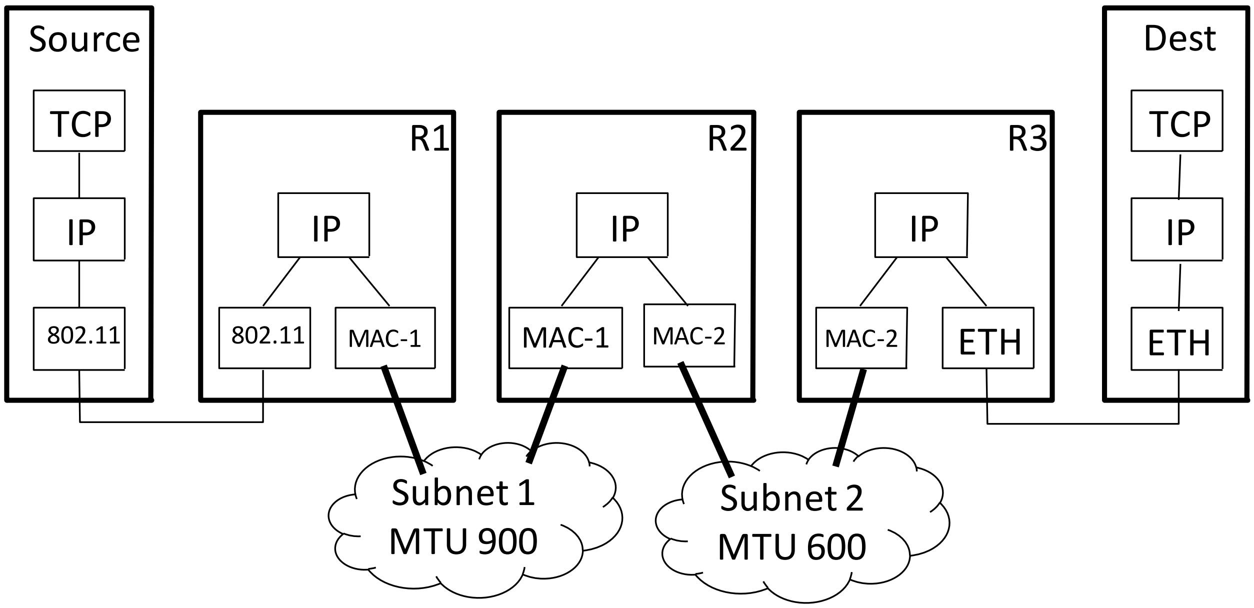
a) Draw a figure of the final spanning tree. Be sure to indicate the root port for each bridge (except the root bridge), the designated port for each LAN, and the links and bridges that do not participate in forwarding data frames.

b) Assume that hosts are attached to all LAN's except for LAN A and that the hosts generate traffic with destinations found through the router to the rest of the network. For simplicity assume that the same number of hosts are attached to each LAN (except LAN A), and that all hosts generate traffic at the same rate. The spanning tree as determined in the previous part creates congestion on more LAN's than is necessary. Renumber the bridges so that the level of traffic on the LAN with the most traffic in the final design is as small as possible (except for LAN A). (This is referred to as a min-max solution. For each possible design, there is a LAN that has the maximum level of traffic. Find a design that minimizes this level.) Draw the resulting spanning tree including the new bridge numbers and root and designated ports. You can only change the numbers assigned to the bridges (e.g., links cannot be moved and no new links can be added).

4. Spanning Trees. Chapter 3, number 21.

Hint: for part (b) while the bridge B1 drops all spanning tree messages, assume the bridge B1 forwards all other messages (i.e., data frames). The idea of this problem is suppose that all the bridges except bridge B1 run the spanning tree algorithm. What happens if an old bridge (B1) that was purchased before the spanning tree algorithm was standardized is still utilized in the network. Since the old bridge was designed before the spanning tree messages were standardized, it will not know how to handle those messages. Depending on how the bridge was implemented, it could either drop messages that it does not understand or forward all messages. This problem investigates the implications of these approaches.

5. **IP Fragmentation.**



The problem simply traces the fragmentation of an IP packet sent from a source host to a destination host in the Internet. Suppose that original IP packet sent by the source host contains 1200 bytes of data and a 20-byte IP header. Suppose precisely two of the subnetworks that the packet crosses have minimum transfer units (MTU's) smaller than 1220 bytes. The first one of these subnetworks crossed has an MTU of 900 bytes and the second has an MTU of 600 bytes. (Recall that IP fragmentation breaks data along 8 byte boundaries, so that each time some IP packet is fragmented, the lengths of the fragments, except possibly the last, have length of the form SL+20 bytes. The 20 accounts for the IP headers.) In the following give the length in bytes. For each part give the values for the following fields in the IP header: Length, M bit in the flags, and Offset,

- **(a)** Give the values for each of the IP packets sent by R1 over the first subnetwork to R2.
- (b) Give the values for each of the IP packets sent by R2 over the second subnetwork to R3
- (c) Give the values for each of the IP packets sent by R3 that reach the destination host.

Hint: recall the Ethernet MTU is 1500 bytes, and 802.11 has a larger value for its MTU (at least 2304 B but depends on which options are used).

6. **IP Fragmentation. Chapter 3, number 34**
7. **IP Fragmentation. Chapter 3, number 41**