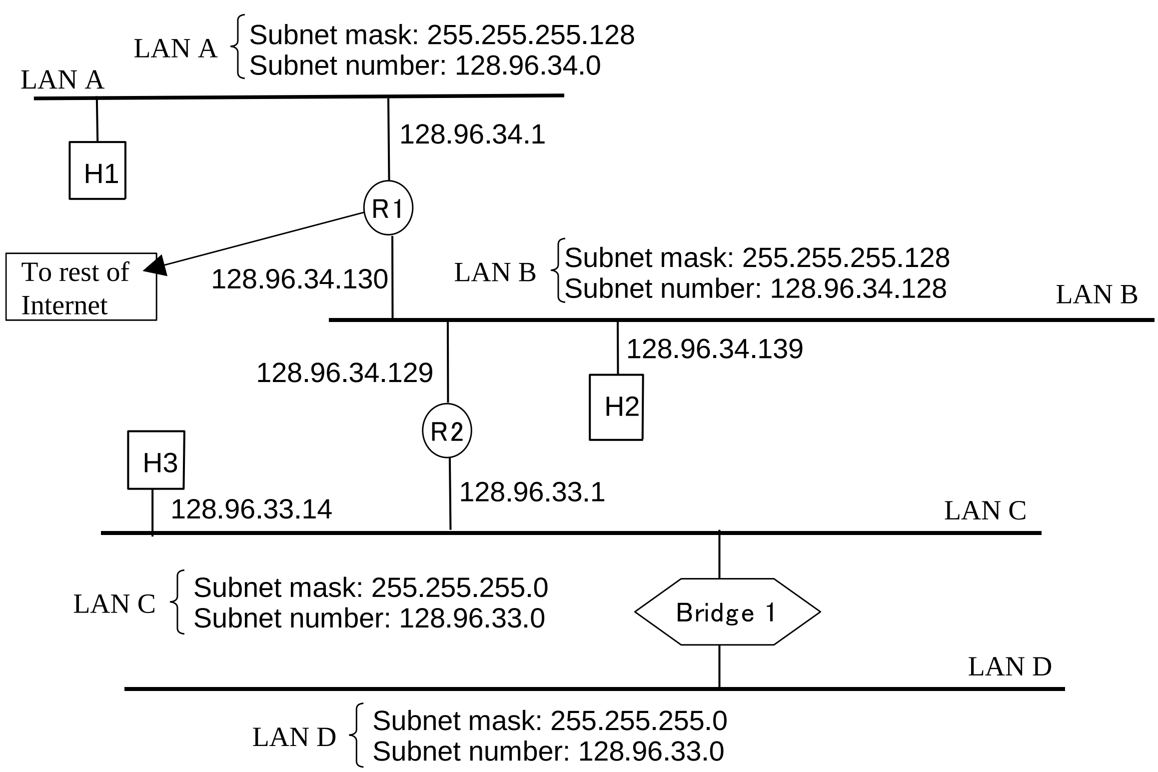
ECE 4380/6380: Computer Communications **Spring 2017**
Problem Set 7 **Due: in class, Friday, March 31**

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

1. **Subnetting. Chapter 3, number 55**
2. **Subnet design. Chapter 3, number 68**
3. **Subnet design.**

Consider the network shown below. Originally Department β had control of two LANs: A and B, and the department has expanded by adding LAN E along with a new router: R3. Router R3 is used to connect LAN B to LAN E. Department β is restricted to using one block of 256 addresses and the addresses start with 128.96.34. Department β's original configuration divided the addresses into two blocks of 128 addresses each for LAN's A and B. LAN A was assigned host addresses 0 to 127, and LAN B was assigned addresses 128-255. Department β would like to plan for a total of 70 hosts on LAN A, 50 hosts on LAN B, and 25 hosts on LAN E. Furthermore, no IP addresses should be changed on LAN A. Also, on LAN B host H2 and routers R1 and R2 should not change their IP addresses (though they can change subnet masks if necessary). Describe what changes, if any, are required in the way the Department β assigns IP addresses and subnet masks to the nodes on LANs A, B, and E.

4. **Multiple subnets on a LAN. Chapter 3, number 71.**



5. **IP forwarding.**

Suppose an organization has been assigned a Class B address with network number 128.96. The organization uses subnets to configure a number of local area networks (LANs) some of which are shown in the figure on the previous page (before any changes due to problem 3). Suppose that H2 is configured with only a default route to R1 in its IP forwarding table.

- **(a)** Give the sequence of all Ethernet frames that are transmitted on the LAN's when H2 has a packet to forward to H3. For each Ethernet frame, specify its destination address and the type of packet the frame contains. Assume the network has been idle long enough so that all ARP caches have timed out and H2 has not forwarded any packets to hosts on LAN C or D since it was booted. Also, assume H2 knows H3's IP address. (Hint: including the ARP frames there are nine total frames.)
- **(b)** Because the nodes build ARP caches, not all the frames listed in part (a) are required for H2 to send a sequence of packets to H3. Describe an additional mechanism (besides ARP caching) that is available in IP to reduce the number of frames that are required for H2 to send a sequence of packets to H3. (Hint: review the ICMP messages)

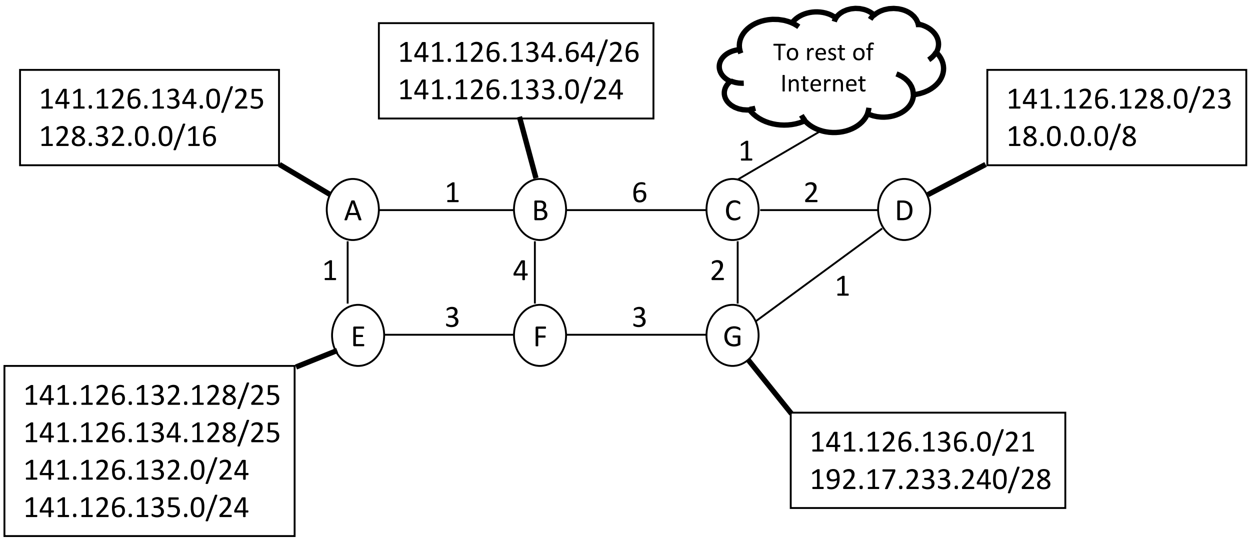
6. **IP Forwarding, LAN Forwarding, ARP, and Subnet Masks. (Variation on problem 51)**

Suppose an organization has been assigned a Class B address with network number 128.96. The organization uses subnets to configure a number of local area networks (LANs) some of which are shown in the figure on the previous page (before any changes due to problem 3).

- **(a)** A user adds a new host, called H5, onto LAN D. However, the user is inexperienced and configures a proper IP address and default router but does not realize that subnets are being used. So, the host defaults to no subnet mask (i.e., 255.255.0.0 because this is a Class B network). Assume that the ARP cache at H5 is initially empty. We did not discuss the domain name service (DNS) in class so assume that H5 already knows the IP addresses for all hosts given in the remainder of this problem. Can H5 successfully send an IP packet to H3? Explain the steps involved and any problems that are encountered. Be sure to give the steps for how LAN addresses are learned, ARP is used, LAN forwarding is used, and IP forwarding is used.
- **(b)** Continuing the situation described in problem (a), can H5 successfully send an IP packet to H2? Explain the steps involved and any problems that are encountered.
- **(c)** Continuing the situation described in problem (a), can H5 successfully send an IP packet to a host attached to the Internet (i.e., an IP address that does not begin with 128.96)? Explain the steps involved and any problems that are encountered.

7. **Forwarding tables with CIDR, Chapter 3, number 72.**
8. **CIDR, and IP Forwarding**

Construct an IP forwarding table for the intra-domain router F in the stub autonomous system shown in the figure below. Router C is the sole border gateway. Assume that F has accurate knowledge of all routers and address assignments. You only need to construct the forwarding table, and you must aggregate super-networks when appropriate so there are as few entries in the forwarding table as possible. The weights assigned to the links are the same for each direction of the link. You do not need to show the execution of the routing protocol, just the final forwarding table which lists the network number, mask length, and next hop. Your forwarding table **must** have a default entry. The lists shown for the reachable networks at each router might not be minimal length, but your final forwarding table must have the minimum number of entries.



(Hints: First consider the forwarding table for node F without considering CIDR. You list all networks, and since C is the border router, make the default entry so that any IP address that does not match an address at nodes A, B, D, E, or G is forwarded to C. Then reduce the size of the forwarding table by using super-nets to take advantage of the CIDR longest match rule, and using the default route to eliminate unnecessary entries.)

Network number / Mask length	Next hop