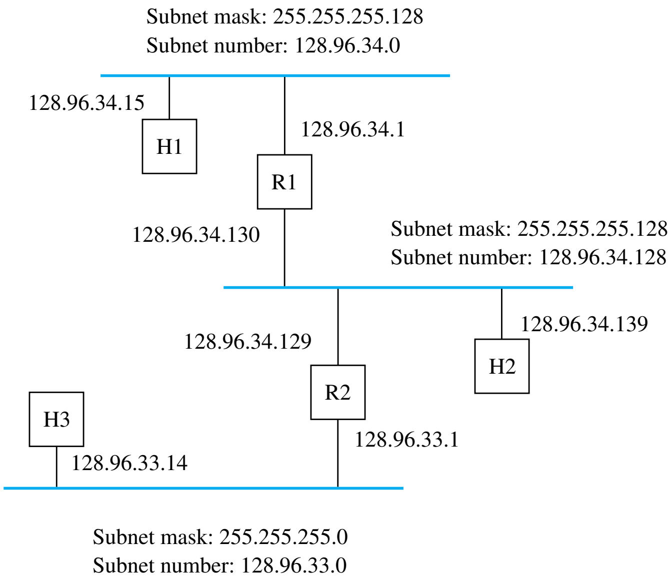
Computer Networks—CS 461

MIDTERM EXAM March 27, 2002

The problems are equally weighted. There are only six of them, so be precise and thorough in your responses.

1. Define the *token bucket* abstraction. Describe how you would implement a *policing* module that ensures a packet source adheres to a given token bucket specification. Think of this module as being in the protocol stack just below the application that generates packets, and just above a transport protocol like UDP. For simplicity, you may assume that the bucket specification and the policing module are expressed in terms of packets rather than bytes.

2. For the network shown below, give the routing tables at both R1 and R2. The tables should be sufficient to reach all networks without a default route. Be sure to include an entry for each directly connected network, labelling the two interfaces on each router as "top" and "botttom", in the obvious way. Mark the entry in each table used when forwarding a packet from H1 to H3.



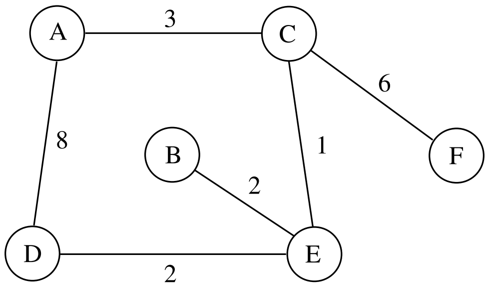
3. Imagine you are asked to design a protocol like TCP, except it is message-oriented rather than byte-stream oriented. Suppose the largest message you can send with the protocol is 1500 bytes and the smallest is 64 bytes (including all headers). Also assume that the protocol is designed for a network with 1Gpbs links, 100ms RTT, and a 60s maximum packet lifetime. How many bits do you need to allocate to the acknowlegement and advertized window fields?

4. For the network given below, give the distance-vector routing table at node B when

   (a) Each node knows only the distances to its immediate neighbors.

   (b) Each node has reported the information it had in the preceding step to its immediate neighbors.

   (c) Step (b) happens a second time.



5. IP is designed to run on top of any networking technology, including IP itself. Running IP over IP is sometimes called tunneling, and it allows you to define a new overlay Internet that, for example, uses a different interpretation of IP addresses. Sketch the headers on a packet traversing this overlay, and explain how demultiplexing and forwarding would be done at both overlay-aware nodes, and conventional routers. What complications arise when you want to enable a given node to run multiple IP overlays at the same time?

6. Video applications typically run over UDP rather than TCP because they cannot tolerate retransmission delays. However, this means video applications are not constrained by TCP's congestion control algorithm. What impact does this have on TCP traffic? Be specific about the consequences.

   Fortunately, these video applications often use RTP, which results in RTCP "receiver reports" being sent from the sink back to the source. These reports are sent periodically (e.g., once a second) and include the percentage of packets successfully received in the last reporting period. Describe how the source might use this information to adjust its rate in a TCP-compatible way.