
EECS 122 - COMMUNICATION NETWORKS - *Spring 2003*
Midterm

Last Name	First Name	SID	email

Problem	Max. Score	Your Score
1	40	
2	20	
3	20	
4	20	
Total	100	

1. Multiple Choice [40%]

1.1. [4%] A world-wide layer 2 network is not feasible with no layer 3 because (check all the boxes that correspond to a correct answer, if any)

- a. The bandwidth of the links is too small
- b. Layer 2 switches don't have enough memory for data packets
- c. The headers are too long
- d. The flat address space leads to unmanageable forwarding tables

1.2 [4%] In IP, a router

- a. Retransmits packets that are not acknowledged in time
- b. Drops packets whose data is corrupted
- c. Drops packets when they become congested
- d. Sends back 3DAs to tell the sources to slow down

1.3 [4%] The functions that UDP adds to IP are

- a. Retransmission of erroneous packets
- b. Detection of erroneous packets
- c. Multiplexing of transmissions to and from other applications
- d. Flow and congestion control

1.4 [4%] HTTP 1.1

- a. Is a transport layer protocol
- b. Establishes TCP connections faster than HTTP 1.0
- c. Utilizes a proxy cache more effectively than HTTP 1.0
- d. Establishes fewer TCP connections than HTTP 1.0

1.5 [4%] CIDR (classless interdomain routing) is designed to

- a. Provide fair service across different classes of traffic
- b. Regulate the flow of traffic between domains
- c. Improve the utilization of the IP address space
- d. Speed up the table lookups that routers perform

1.6 [4%] Fast retransmit is intended to

- a. Increases the bandwidth of router links
- b. Retransmit a missing packet without waiting for a timeout
- c. Increase the transmission rate of links
- d. Modify the increase rate in AIMD

1.7 [4%] The IP routing is decomposed into intradomain and interdomain routing

- a. Because a flat address space is not scalable
- b. To limit the waste of IP addresses
- c. Because there are different routing objectives to satisfy
- d. To optimize the links utilization

1.8 [4%] AIMD (additive increase - multiplicative decrease)

- a. Attempts to share links fairly among connections
- b. Is used in the slow start phase of TCP
- c. Increases the number of connections to multiply throughput
- d. Adjusts the receiver advertised window

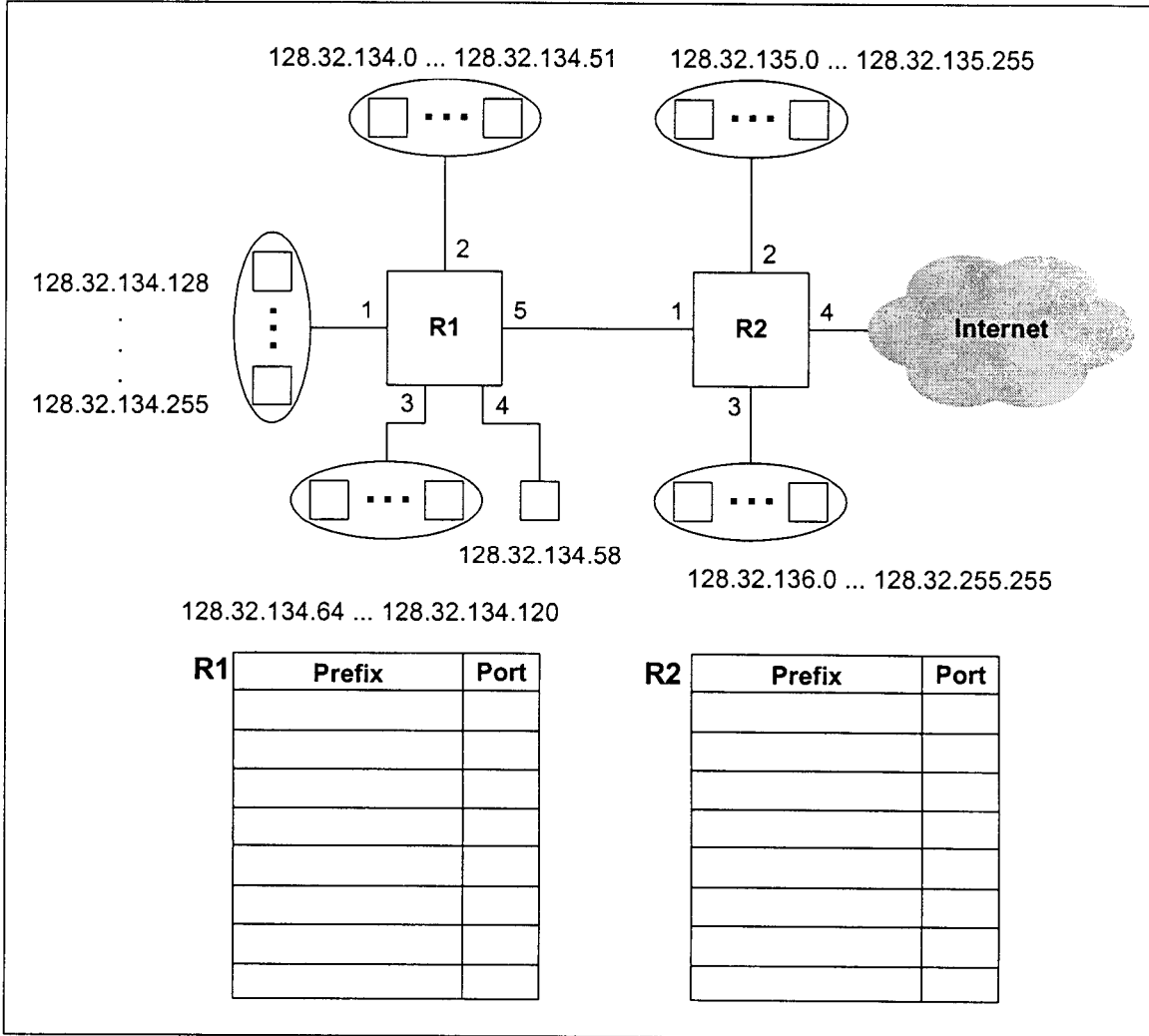
1.9 [4%] WFQ

- a. Is applied at the input queue of a router
- b. Affects the performance of packet dropping schemes such as RED
- c. Requires that the traffic be fluid (i.e., not packetized)
- d. Provides explicit congestion notification

1.10 [4%] TCP

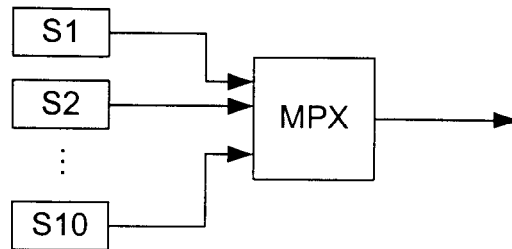
- a. Is particularly efficient with noisy links because of fast retransmit
- b. Favors connections with a large round trip time
- c. Reduces the number of packet retransmissions caused by errors
- d. Avoids saturating the receiver by implementing slow start

2. Problem [20%]. Fill in the routing tables of the routers below using CIDR. That is, specify the prefixes of the ports of the routers. All the nodes of the network 128.32 are shown in the figure.



Show your work here:

3. Problem [20%]. The figure below shows a multiplexer MPX that receives data from 10 sources (S1 - S10). The link rates (including that of the outgoing link) are all equal to 10Mbps. In this problem, we investigate the delays and the buffer requirements of the multiplexer under different multiplexing schemes.



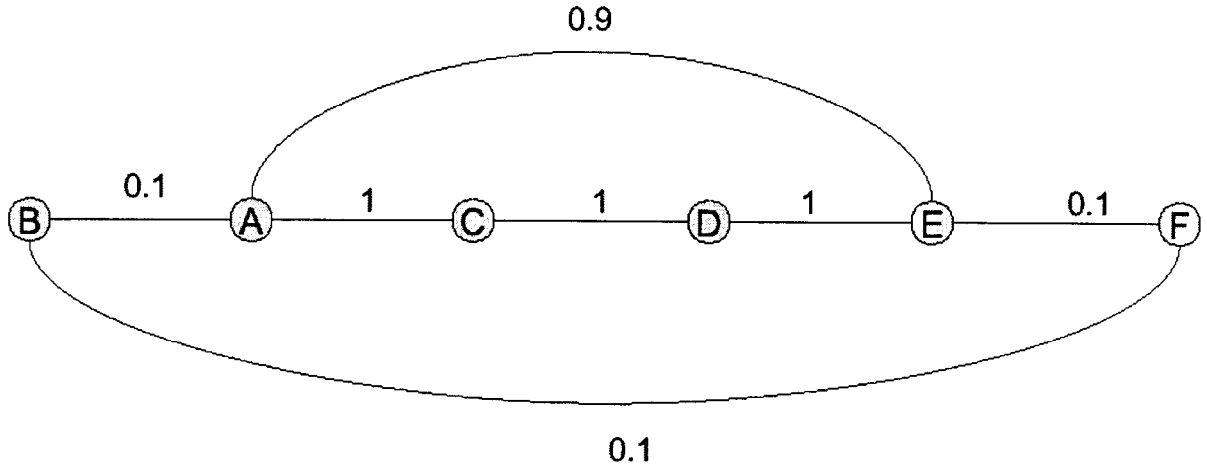
(a) Assume that the sources send packets of 10kbits precisely every 20ms and that MPX uses statistical multiplexing. (MPX uses store-and-forward, with no cut-through.) What is the maximum buffer occupancy at MPX and what is the maximum delay of packets through MPX? (Define the delay of a packet as the difference between the departure time of the last bit of the packet and the arrival time of that last bit.)

(b) Assume that the sources send packets of 10kbits precisely every 20ms and that MPX uses time division multiplexing. Specifically, MPX divides its outgoing link into frames of 1ms. Each frame consists of 10 slots that MPX allocates to the 10 sources in a round-robin way. That is, S_k uses the k -th slot of each frame, for $k = 1, 2, \dots, 10$. For simplicity, we ignore any overhead that the frames and slots might require to keep the receiver synchronized. What is the maximum buffer occupancy at MPX and what is the maximum delay of packets through MPX?

(c) Assume that the sources send bursts of packets. Specifically, assume that in any 1 second epoch each source can send up to 50 packets of 10kbits. Assume that MPX uses statistical multiplexing. What is the maximum buffer occupancy at MPX and what is the maximum delay of packets through MPX?

Show your work here:

4. **Problem** [20%]. In the six-node network shown below the nodes compute shortest path distances using the Bellman Ford distance vector method.



(*) Assume that time is slotted ($t = 1, 2, \dots$) and that a node sends its distance vectors at the beginning of a slot. A distance vector transmitted on a link in the beginning of a slot arrives at its destination before the end of that slot. All distance estimates are computed using the most recently available information.

What are node A's distance vectors at the end of time slots 1, 2, 3, 4 when:

- (a) The problem is as stated in (*)
- (b) The problem is as stated in (*), except that nodes B and F send estimates only every **third** time slot (A, C, D and E send estimates at the beginning of every time slot).
- (c) The problem is as stated in (*) except that the link (E,F) has become so congested that it takes **three timeslots** to traverse, i.e. a distance vector from either E or F sent over the link at the beginning of time slot j , is only received at the other end of the link at the end time slot $j+2$. All of the nodes and the rest of the links behave as in (*).

Show your work here: