CS 421: COMPUTER NETWORKS **FALL 2015**

FINAL
December 28, 2015
150 minutes

Name: _____

Student No: _____

Show all your work very clearly. Partial credits will only be given if you carefully state your answer with a reasonable justification.

Q1	
Q2	
Q3	
TOT	

1)

a) (4 pts) Give two disadvantages of using a Go-Back-N window size which is substantially larger than the minimum window size necessary for full bandwidth utilization.

b) (5 pts) Is TCP appropriate as the transport layer protocol for an IP telephony application, which requires that a minimum throughput must always be supported by the network? Why or why not?

c) (5 pts) Which of the two loss events in TCP, timeout or fast retransmission, is an indication of a more serious congestion in the network? Why?

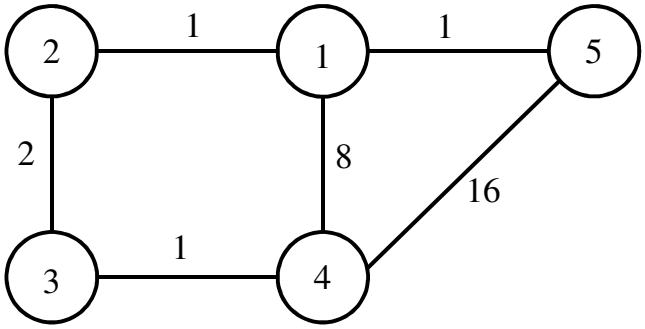
d) (8 pts) Assume that the bandwidth of a connection is 10 Mbps ($10x10^6$ bps) and the distance between the two end-points of the connection is 1000 km. The propagation speed is $2x10^5$ km/s. Assume that each data segment contains 1250 Bytes including the headers and the ACK packets are 40 Bytes long. Assuming that no packets are lost, what should be the **minimum window size (in terms of data segments)** in order to achieve full bandwidth utilization for this connection?

e) (10 pts) Suppose that a file composed of 50 segments, each with a size of 1250 Bytes, will be transferred over a TCP connection with a round-trip delay of 10 ms and bandwidth of 10 Mbps, i.e., $10x10^6$ bps. Assume that no loss event occurs during the entire file transfer. Further assume that the slow start threshold (ssthresh) at the beginning of the TCP connection is infinitely large. The Receive Window, RcvWin, is advertised as 10,000 Bytes by the receiver during the entire transfer of the file. Ignore all processing and queueing delays and assume that ACK messages have a negligibly small transmission time. How long does it take to transmit the entire file and receive the final ACK?

2)

a) (10 pts) The network below uses the distance-vector routing algorithm. Assume the following:

- Links have the same cost in both directions.
- Nodes exchange their routing info once every second, in perfect synchrony and with negligible transmission delays. Specifically, at every t = i, i = 0, 1, 2, 3,..., each node sends and receives routing info instantaneously, and updates its routing table; the update is completed by time t=i+0.1.
- At time t = 0, the link costs are as shown below and the routing tables have been stabilized. At time t = 0.5, the cost of the link (1,2) becomes 10. There are no further link cost changes.
- Route advertisements are **only exchanged periodically**, i.e., there are no immediate route advertisements after a link cost change. Hence the first route advertisement after the link cost change at t = 0.5 sec occurs at t = 1.0 sec. *Note:* However, whenever a link cost change occurs, the two nodes at the endpoints of this link immediately make corresponding changes in their distance tables.
- Assume that the distance vector algorithm **does not use poisoned reverse**.



Give the evolution of the distance tables with respect to destination 5. Specifically, give the distance table entries for destination 5 at nodes 1-4, for t = 0.1, 0.5, 1.1, 2.1, ..., **until** all distance vectors stabilize. Present your final answer in the table given below where $D^i(j)$ is the distance vector element denoting the distance from *i* to *j*.

Time, t	$D^1(5)$ via			$D^2(5)$ via		$D^3(5)$ via		$D^4(5)$ via		
	2	4	5	1	3	2	4	1	3	5
0.1										
0.5										
1.1										
2.1										
3.1										
4.1										
5.1										
6.1										
7.1										
8.1										
9.1										

b) (4 pts) Assume that there is a packet generated at t=3 by node 2 destined for node 5 in question 2.a). Discuss whether this packet will be delivered to node 5 or not.

c) (6 pts) You are given the assignment of setting subnet addresses for 6 campuses of your company. The number of Internet connected PCs in each department is given in the following table. Assume that the 151.198.128.0/17 address block is given to you for this purpose. Use the following table to show the addresses of the six subnets that you created.

Campus	# of PCs	Subnet address (CIDR format)
1	5000	
2	2500	
3	2000	
4	900	
5	600	
6	550	

d) (6 pts) The largest IP router can hold 200,000 entries in its forwarding table while the largest Ethernet switch can hold 1,000,000 entries in its switch table. However, a large IP network can support many more hosts than a large Ethernet network. Why?

e) (6 pts) State two modifications included in IPv6 different from IPv4 that allow a router to process a packet faster.

3)

a) (6 pts) Suppose the data sequence 0011101100 is transmitted using the generator sequence 110011101. Compute the CRC bits and the transmitted bit sequence.

b) (6 pts) Consider a 100 Mbits/sec Ethernet based LAN. Assume that the propagation speed for the signal over the Ethernet is $2x10^8$ m/sec. The distances between the nodes in this Ethernet are given in the following table. Compute the minimum frame size in bytes so that the CSMA/CD algorithm will work properly for this LAN.

Distance (m)	A	B	C	D
A	-	300	450	350
B	300	-	350	250
C	450	350	-	400
D	350	250	400	-

c) (6 pts) Why does the efficiency of Ethernet increase as the distances between the nodes decrease? Describe your reasoning in words instead of giving an equation.

d) Assume that there are four nodes A, B, C and D on a 100 Mbits/sec Ethernet. Suppose these four nodes are involved in a collision, which is the third collisions for A's and B's frames, second collision for C's frame and fourth collision for D's frame. After the collision is detected (we assume that all nodes detect the collision exactly at the same time), nodes calculate their backoff times according to the binary exponential backoff algorithm.

i. (6 pts) What is the probability that the first transmission after the above collision will be another collision involving nodes C and D only?

ii. (6 pts) What is the probability that the first transmission after the above collision will be another collision involving nodes A and B only?

iii. (6 pts) What is the probability that the first transmission after the above collision will be another collision?