Data Networks Summer 2007
Homework #2

Assigned May 21, 2007
Due May 28 in class

Name: _____

Email: _____

Student ID: _____

Problem	Points
1	
2	
3	
4	
5	
Total	

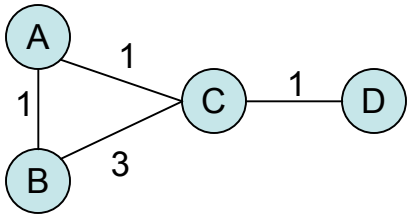
In this homework, for simplicity, K means 10^3, M means 10^6, and G means 10^9. But read the green box on page 44-46 of Peterson & Davie to understand the precise meaning of these notations in different contexts. Show your work when appropriate, do not just write down a single number as your answer if you want full credit.

Problem 1 (20 points): Suppose you are designing a multi-access (i.e. broadcast) wired network using CSMA/CD (Carrier Sense Multiple Access/Collision Detect) mechanisms similar to the Ethernet for media access control. Assume that in your design, the network's link speed is 5Mbps, frame sizes may range from 100 bytes to 5000 bytes. Also assume that data signal propagates on the network link at a speed of $2*10^8$ meters per second.

(a) What is the maximum allowable link length (in meters) between any pair of hosts connected to the same link? Show your work. (15 points)

(b) If the link length between two hosts is longer than this maximum, what problem may occur? Only a short answer is required. (5 points)

Problem 2 (20 points) One of the main problems with the distance vector routing algorithm is the potential to form a routing loop.



(a) Based on the network shown above, describe a sequence of events that will cause a routing loop to form (and thus lead to the count-to-infinity situation). Assume no poison reverse is used, no triggered update is used (i.e. with periodic update only). (8 points)

(b) Poison reverse is an addition to the basic distance vector routing algorithm. The idea is, if a node X uses node Y as its next hop to get to node Z, then X would advertise a cost of infinity for node Z when sending a distance vector update message to node Y. Do you think poison reserve is sufficient to prevent routing loop? Explain your answer in detail. (8 point)

(c) In the inter-domain routing protocol BGP, the route from one autonomous system (AS) to a destination AS is typically chosen by picking the neighbor AS who advertises the shortest AS path to the destination AS as the next hop. What mechanism does BGP use to prevent routing loop? (4 points)

Problem 3 (20 points) – (Peterson & Davie p.152 problem 15) Prove the Internet checksum computation shown in the text is independent of byte order (host order or network order) except that the bytes in the final checksum should be swapped later to be in the correct order. Specifically, show that the sum of 16-bit word integers can be computed in either byte order. For example, if the ones complement sum (denoted by +') of 16-bit words is represented as

$$[A,B] +' [C,D] +' \ldots +' [Y,Z]$$

The following swapped sum is the same as the original sum above:

$$[B,A] +' [D,C] +' \ldots +' [Z,Y]$$

(Note: You need to show a general mathematical proof)

Problem 4 (20 points) Given the following intra-domain routing table (learned via OSPF) and inter-domain routing table (learned via BGP) at a router, construct the final routing table for all destination networks learned. Your final routing table should have a column for destination network address pattern, CIDR mask, and next hop (R1…R6).

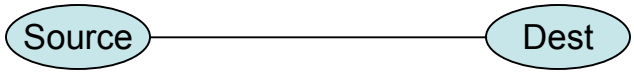
Intra-domain routing table (from OSPF)

Address Pattern	CIDR Mask	Next Hop
128.42.222.3	255.255.255.0	R1
128.42.128.4	255.255.128.0	R2
18.0.0.0	255.0.0.0	R4
128.42.127.3	255.255.248.0	R6
128.42.216.0	255.255.248.0	R5
128.42.128.4	255.255.0.0	R3

Inter-domain routing table (from BGP)

Address Pattern	CIDR Mask	BGP Next Hop
128.2.111.0	255.255.255.0	128.42.60.1
12.222.128.0	255.255.128.0	18.111.12.1
133.0.0.0	255.0.0.0	128.42.120.32
36.33.88.0	255.255.248.0	128.42.226.4
73.128.222.0	255.255.248.0	128.42.124.45
55.34.0.0	255.255.0.0	128.42.220.121

Problem 5 (20 points): Your company is designing a specialized reliable transmission protocol that will be used to transfer data from a source node to a destination node over a private datagram network link that directly connects the source and the destination.



These are the various characteristics given to you:

1. Link speed = 1Mbps
2. Link one-way propagation delay = 245 ms
3. Data packet size = 1000 bytes (this includes packet header)
4. Bit errors are extremely rare; when it does occur, it's always only one bit error per data packet.

Your job is to define part of the packet header for the data packets generated by the source. In particular, you need to define the data packet header field(s) needed to implement the most appropriate and best performing reliable transmission mechanism(s) for the above characteristics. You should choose the size of the field(s) such that the header overhead is minimized.

Note: Source and destination address fields are irrelevant. You only need to define the field(s) that are relevant to the reliable transmission mechanism(s) you choose to implement for this network.

For each data packet header field you need in your design, states: (a) the size of the field in number of bits, (b) the purpose of the field in detail, (c) why the field size you choose is the most appropriate.