Department of Electrical and Computer Engineering
Prairie View A&M University

Doctoral Preliminary Examination

Computer Networks
Spring 2018

Name of the student:

Signature of the student:

1	46	
2	8	
3	10	
4	16	
5	10	
6	10	
Total	100	

Instructions:

This is a CLOSED BOOK Examination. You can use approved calculator.

1. (45 points) Short answers.
    a. (8 points) For each of the following four networks, illustrate and discuss the consequences if a connection fails: i) Five devices arranged in a mesh topology; ii) Five devices arranged in a star topology (not counting the hub); iii) Five devices arranged in a bus topology; and iv) Five devices arranged in a ring topology.

b. (4 points) Assume we have created a packet-switched internet. Using the TCP/IP protocol suite, we need to transfer a huge file. What are the advantage and disadvantage of sending large packets?

c. (8 points) Match the following to one or more layers of the TCP/IP suite:
    i. Route determination
    ii. Connection to transmission media
    iii. Providing services for the end user
    iv. Creating user datagrams
    v. Responsibility for handling frames between adjacent nodes
    vi. Transforming bits to electromagnetic signals

d. (5 points) What is bandwidth in bits per seconds? What is throughput? Compare the differences between these two.

e. (5 points) What is the piece of information in a packet upon which the forwarding decision is made in each of the following approaches to switching?
    i. Datagram approach
    ii. Virtual-circuit approach

f. (5 points) We can roughly divide line coding schemes into five broad categories, please list at least four of them.

g. (4 points) Is the use of checksum for error control optional or mandatory in:
    i. UDP?
    ii. TCP?

h. (4 points) Can a program written to use the services of UDP be run on a computer that has installed TCP as the only transport-layer protocol? Explain.

i. (3 points) Define scrambling as one coding scheme.

2. (8 points) A signal with 200 milliwatts power passes through 10 devices, each with an average noise of 2 microwatts. What is the SNR? What is the SNRdb? If the peak voltage value of a signal is 20 times the peak voltage value of the noise, what is the SNR? What is the SNRdB?

3. (10 points) What is the total delay (latency) for a frame of size 5 million bits that is being sent on a link with 10 routers each having a queuing time of 2us and a processing time of 1us. The length of the link is 2000km. The speed of light inside the link is $2x10^8 m/s$. The link has a bandwidth of 5 $Mbps$. Which component of the delay is dominant? Which one is negligible? (Hint: Latency = propagation time + transmission time + queuing time + processing delay.)

4. (16 points)Draw the graph of the schemes:
    a) NRZ-L (Non-Return-to-Zero-Level);
    b) NRZ-I (Non-Return-to-Zero-Invert);
    c) Manchester;
    d) Differential Manchester

   using each of the following data streams:

    i) 00000000
    ii) 11111111
    iii) 01010101
    iv) 00110011

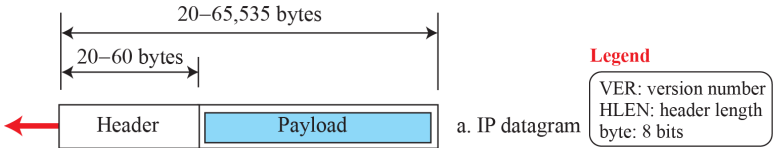
   assuming that the last signal level has been positive. From the graphs, guess the bandwidth for this scheme using the average number of changes in the signal level.

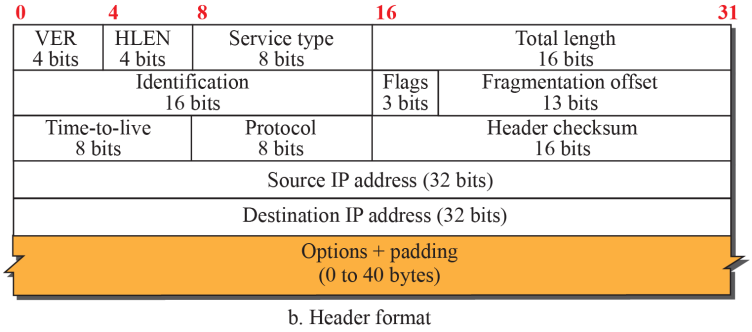
5. (10 points) An IP datagram has arrived with the following partial information in the header (in hexadecimal):

   45000054 00030000 2006…

   a) What is the header size?
   b) Are there any options in the packet?
   c) What is the size of the data?
   d) In the packet fragmented?
   e) How many more routers can the packet travel to?
   f) What is the protocol number of the payload being carried by the packet?

Below attach the header format:



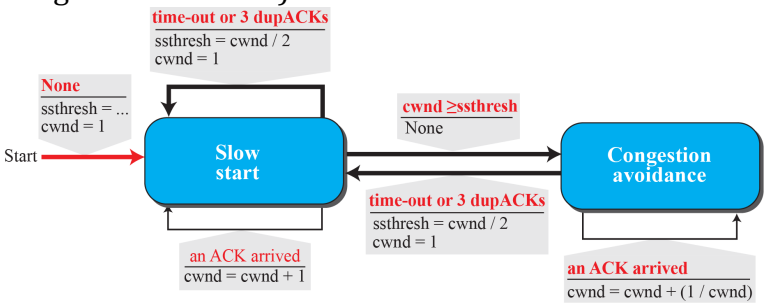


b. Header format

ICMP: 01 UDP: 17
IGMP: 02 OSPF: 89
TCP: 06

Some protocol values

6. (10 points) Below figure shows the FSM for Taho TCP. It is used for congestion control. (ssthresh means slow start threshold; cwnd means congestion window.)



Please use this FSM as guidance to analyze the following graph, which represents an example of congestion control by Taho TCP (Each small circle marks an ACK arrives).

a. Identify the intervals of time when TCP slow start (SS) is operating. Mark the intervals of SS on the graph, give some reason why SS is used, and explain why it does a better job than congestion avoidance (CA) for that interval.
b. Identify the intervals of time when TCP (CA) is operating. Mark the intervals of CA on the graph, explain why CA is used instead of SS during that interval;
c. Identify in which round, the segment loss is detected by a triple duplicate ACK?
d. Identify in which round, the segment loss is detected by timeout?
e. Could you summarize the mechanism used in TCP Congestion control and briefly explain it.