CS:352 FALL 17 Mid Term 1 Sample Student Name: RUID:

12 Questions: Question 1-8: 5 Points Each; Question 9-12: 15 Points Each.

1. List Five Layers of Internet Protocol Stack

   Application Layer, Transport Layer, Network Layer, Link Layer, and Physical Layer

2. Differentiate between circuit-switched network and packet-switched network

   Circuit Switching: dedicated channel has to be established before the call is made between users; Packet Switching: it is not required to establish the connection initially, and the connection/channel is available to use by many users.

3. Differentiate between active FTP and passive FTP connection

   Active FTP: a server initiates the data transmission;

   passive FTP: a client initiates the data transmission.

4. List two Key Differences Between TCP and UDP

   TCP: in-order, reliable

   UDP: out-of-order, unreliable

5. Explain Why the Stop and Wait protocol is effective for flow control but NOT very efficient

   It can avoid the buffer overflow on the receiver side by waiting for the receiver's ACK before sending a new packet (effective), but the waiting time for ACK may be very long, and packets cannot be sent with a pipelining fashion (not very efficient).

6. List Formulas for Smoothed Round Trip Time (SRTT) and Retransmission Timeout Interval (RTO)

   $SRTT = a\ SRTT + (1-a)\ RTT_{\text{arriving ACK}}$ $RTO = b * SRTT$

7. List Four Flow Control Algorithms for UDP

   Stop and Wait on Noiseless Channel; Stop and Wait on Noisy Channel

   Sliding window with Go-Back-N; Sliding window with Selective Repeat

8. Define a Congestion Window in a TCP Congestion Control Protocol

   It maintains TCP's best estimate of amount of outstanding data to allow in the network to achieve self-clocking.

9. Suppose you click on a link to obtain a Web page in your Web browser. Assume that the IP address for the associated URL is not cached in your local host, and 7 DNS servers are visited before your host receives the IP address from DNS; the successive visits incur an RTT of RTT1,...,RTT7. If the Web page associated with the link contains a HTML referencing 5 very small objects on the same server, how much time it will take from when the client clicks on the link until the client receives 5 objects assuming (i) we use Persistent HTTP connection with pipelining or (ii) we use non-persistent HTTP with 2 parallel connections?

   (i) Persistent connection with pipelining

   $RTT_1 + \cdots + RTT_7 + 2RTT_o + RTT_o = 3RTT_o + RTT_1 + \cdots + RTT_7$.

   (ii) non-persistent HTTP with 2 parallel connections

   $RTT_1 + \cdots + RTT_7 + 2RTT_o + 3 \cdot 2RTT_o = 8RTT_o + RTT_1 + \cdots + RTT_7$

10. A TCP connection is established between two hosts A and B connected over 4 links in tandem. The bandwidth of the first link is 1 Mbps (bps=bits per sec, M = 10^6), and the bandwidth of the next 3 links is ½ of the previous link. What is the maximum bandwidth of the connection?

    Link1 1, Link 2 is ½ , Link3 ¼, Link 4 is 1/8 , so the max bandwidth is the same as the bottleneck link, which is .125 Mbps or 125 Kbps.

11. Consider the GO back N protocol with a sender window size of 3 and a sequence number starting from 1. At some time t, the receiver sends an acknowledgment for 6 (received all packets up to 6). What are the possible sequence numbers of packets in the sender's window at time t?

    If the sender has received all the previous acks then the window will be [6,7,8];
    if the sender has not received any of the acks in the window, then it will be [4,5,6] and [5,6,7].

12. A TCP connection with a flow control window of 40 packets uses slow start with a minimum congestion window of 2 with ss_thresh=40. How many RTTs are required to send 25 packets (with sequence number 1 through 25), assuming packet with sequence number 6 is lost and retransmitted. No other packets are lost.

    CW=2: 1,2
    CW=4: 3,4,5,6
    CW=7: 7,8,9,10,11,12,13
    Retransmit 6
    CW=2: 14,15
    CW=4: 16,17,18,19
    CW=8: 20,21,22,23,24,25

    Answer: 7 RTTS