CSE 473 – Introduction to Computer Networks *Jon Turner*

Quiz 3 Solution

Your name here: *10/15/2012*

1. (5 points). Consider a situation in which 1000 clients are trying to download a 10 MB file from a server. If the server has a 100 Mb/s access link and the clients have access links with a downstream rate of 2 Mb/s, how long does it take to download the file to all clients, under ideal conditions (you may ignore the time to establish a TCP connection to the server).

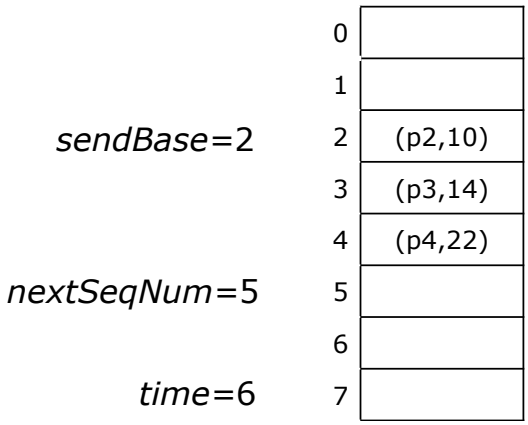
   The total download bandwidth is 2 Gb/s, so the server's access bandwidth is the limiting factor. The number of bits that the server must send is 80 gigabits, so under ideal conditions, it would take about 800 seconds to deliver the file to all clients.

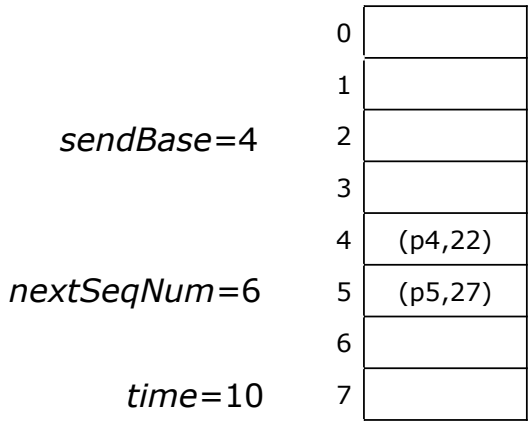
   Now, consider the peer-to-peer situation, in which there is no server and one peer holds the file to be distributed. Assuming that the upstream rate from each peer is 1 Mb/s and the downstream rate is 2 Mb/s, how long does it take to distribute the file to all peers?

   In this case, the limiting factor is the upstream rate from the peers, so the time is 80 Mb/(1 Mb/s), so 80 seconds.

2. (5 points) The diagram at left below shows the state of the sending side of a sliding window protocol with a window size of 4 and the selective repeat feature. The array represents the send buffer and each pair in the buffer represents a packet and its sequence number, together with the time at which it is scheduled to be retransmitted. (so, for example, the pair (*p*3,14) denotes a packet with sequence number 3, which is to be retransmitted at time 14).

   Suppose that at time 7, the application passes us a new payload to be sent, at time 8, we receive an ack with sequence number 3, and that at time 9, we receive an ack with sequence number 2. Show the state of the sender at time 10, in the right-hand diagram. Assume that the timeout used for retransmitting packets is 20 time units.





   If no additional payload or ack is received before time 25, what is the next thing that should happen and how does it affect the sender's state?

   At time 22, packet p4 should be retransmitted and its retransmit time should be increased to 42.