18-345
Introduction to Telecommunication Networks
Homework 5 Solutions

November 12, 2008 **Due: November 19, 2008**

1. What is the fastest line speed at which a host can send out 1500-byte TCP payloads with 120-sec maximum packet lifetime without having the sequence numbers wrap around? You need to add the TCP, IP & Ethernet overhead (header size) while calculating the packet size which is transferred over the wire. Assume that Ethernet frames may be sent continuously.

   Solution:
   The goal is to send 2^{32} bytes in 120 sec or 35,791,394 payload bytes/sec.
   This is 23,860 1500-byte frames/sec. The TCP overhead is 20 bytes. The IP overhead is 20 bytes. The Ethernet overhead is 26 bytes. This means that for 1500 bytes of payload, 1566 bytes must be sent. If we are to send 23,860 frames of 1566 bytes every second, we need a line of 299 Mbps. With anything faster than this we run the risk of two different TCP segments having the same sequence number at the same time.

2. Hosts A and B transfer data according to the three phases of TCP connection. Fill in the sequence numbers and the ACK numbers of the following packet sequence, which shows the start of the TCP connection, so that the numbering is consistent.

   Solution:
   (_###_) is the space student filled in

   A -> B: SYN, Seq_no = 125
   B -> A: SYN, ISN Seq_no = __*4000*_,
   ACK, Ack_no = __*126*_

   A-> B: Seq_no = __*126*_
   ACK, Ack_no = 4001

3. Why does UDP exist? Would it not be enough to let user processes send raw IP packets?

   Solution:
   No. IP packets contain IP addresses, which specify a destination machine.
   Once packet arrives, the network handler needs to know which process to give it to. UDP packets contain a destination port. This information is essential so they can be delivered to the correct process.

4. ‘Traceroute’ is a Linux utility to find route from local host to a remote host. Refer to lecture 20 notes for details. The Windows equivalent of traceroute is ‘tracert’.
Use ‘traceroute’/’tracert’ to find the route to www.ox.ac.uk and www.mit.edu
Observe the routers found along the path to both these locations. At what point do the routes diverge? Why does this happen?

Solution:
The results differ for this question. The routers are common over the access network till the point the ISP is reached. After this point, local requests are routed differently from international ones.

5. Explain why multiplicative decrease and additive increase is used in congestion control mechanisms?

Solution:
When congestion is detected you need to back off quickly to eliminate the congestion. When you increase traffic to use available bandwidth you want to do so slowly to avoid congesting the link.