Homework Assignment #4[1]

Due: Friday Dec. 7th @ 3:50PM

EE122: Introduction to Communication Networks

(Fall 2007)

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Turn in as **hardcopy** to the drop box in **240 Cory**.

1. (a) Kurose & Ross, Chapter 2, p. 186:
   i. P21.
   ii. P22.
   (b) Kurose & Ross, Chapter 6, pp. 581-582:
   i. P8, parts (a), (b), (c), and (e) (not part (d)).
   (c) Kurose & Ross, Chapter 7, pp. 672-673:
   i. P23.
   (d) Kurose & Ross, Chapter 8, p. 751:
   i. P9.

2. **Sizing Header Fields**. You are designing a reliable, sliding window, byte-stream protocol similar to TCP. It will be used for communication with a geosynchronous satellite network, for which the bandwidth is 1 Gbps and the RTT is 275 ms. Assume the maximum segment lifetime is 30 seconds.

   (a) How many bits wide should you make the *AdvertisedWindow* and *SequenceNum* fields?

   (b) If *AdvertisedWindow* is 16 bits, what upper bound would that impose on the effective bandwidth?

   (c) If it turns out that 0.5% of the packets sent over the path are lost, what throughput would you expect a long-running TCP connection to achieve?
   Assume a value of *AdvertisedWindow* large enough to not impede performance.

[1] Version 1, Nov 20.

3. **QoS.**

   (a) Suppose the capacity C of a link is 18. Assume that 4 sources—S1, S2, S3, and S4—are trying to send over the link at rates of $r_1 = 2$, $r_2 = 4$, $r_3 = 5$, and $r_4 = 8$, respectively. What is the max-min fairness allocation?

   (b) For each of the following statements, indicate whether it applies to Integrated Services (IntServ), Differentiated Services (DiffServ), and/or Best Effort. (A given statement can apply to more than just one type of service.)

      i. The service is provided end-to-end.
      ii. Among the three, requires the most state in routers.
      iii. Is widely available in the Internet today.
      iv. Provides isolation and guarantees among aggregated flows but not individual connections.

4. **Queueing Theory.** Jorge wants to find the average number of people in his office hours, which are from 1PM-2PM. He observes the following three people and the times that they arrive and leave:

   - Alice: 1:00-1:20PM
   - Bob: 1:10-1:45PM
   - Eve: 1:40-2PM

   Use Little's Law to compute the mean number of people in his office.

5. **Time-Sequence Plots.**

   (a) For the packet trace (recorded using `tcpdump`) at `http://inst.eecs.berkeley.edu/%7Eee122/fa07/hw/hw4-trace1.tcpdump`, construct a time-sequence plot for the data packets and acknowledgments, and use it to identify:

      - The approximate RTT.
      - The overall throughput.
      - The largest effective window size used.
      - The approximate maximum throughput obtained over two or more flights of packets.
      - Whether the connection is ever limited by the advertised window.

   (b) Construct time-sequence plots for the packet traces at `http://inst.eecs.berkeley.edu/%7Eee122/fa07/hw/hw4-trace2.tcpdump` and `http://inst.eecs.berkeley.edu/%7Eee122/fa07/hw/hw4-trace3.tcpdump`. For these traces, identify retransmitted packets and for each note whether it occurred due to Timeout or Fast Retransmission. For the latter, does the plot indicate that the sender also used Fast Recovery?

   Include copies of your plots with your answers.