Homework Assignment #4 - Due Nov 29 @ 3:50 PM

EE122: Introduction to Communication Networks

(Fall 2006)

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1. Peterson & Davie Exercise 6.11, part (a) (no need to do part (b)), but using the following table:

Packet	Size	Flow
1	200	1
2	200	1
3	160	1
4	80	2
5	240	2
6	90	3
7	180	3
8	180	3

2. 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.

3. Suppose, for TCP's RTO estimation, that *EstimatedRTT* is 4.0 at some point and subsequent measured RTTs all are 1.0. If the initial value of *Deviation* was 0.75, how long does it take before the *TimeOut* value, as calculated by the Jacobson/Karels algorithm, falls below 4.0? Use $\delta = 1/8$.

4. Consider a network path with a 100 ms round-trip time and a 100 Mbps bottleneck link between two hosts, A and B. At time t_1, host A connects to host B using TCP (including its connection management and congestion control protocols) and then sends 60 KB of data to it, sending the last byte of data at time t_2. Assume the packet size available for carrying data is 1500 bytes (ignore header overhead), there are no packet losses, there is sufficient buffering at the receiver, and the receiver acknowledges every packet.

   What is the average data throughput delivered between times t_1 and t_2 . . .

   (a) . . . if A uses slow-start.

   (b) . . . if A uses pure AIMD (CWND increases by exactly one packet per RTT).

   (c) . . . if A uses the form of AIMD that increments CWND by a computed number of bytes for every incoming ACK, assuming A will only send full-sized packets.

   You need only compute the throughput approximately—don't worry about minor effects such as the addition to RTT of the transmission time for the 1500-byte packets. The point is to work through the effects of slow start and congestion avoidance.

5. Dilip wants to find the average number of people in his office hours, which are from 11AM-noon. He observes the following three people and the times that they arrive and leave:

   - Alice: 11:00-11:20PM
   - Bob: 11:10-11:45PM
   - Eve: 11:40-noon

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

6. The `openssl` utility provides a (somewhat clumsy) way to inspect SSL certificates. To figure out how to use it, enter:

   ```
   openssl s_client help
   ```

   You will want the "`-connect`" option.

   (a) Probe the server *www.amazon.com* on the usual SSL port (which you can find from */etc/services*) in order to dump out the SSL certificate used by Amazon.

   What country, state, city, and organization appears to be associated with the certificate?

   (b) What organization (company) provides the "Secure Server Certification Authority"?

   (c) How do these answers differ for *www.berkeley.edu*?

   (d) How do these answers differ for *www.lbl.gov*?

7. For each of the following three traces, 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.
   - For any retransmission, whether it occurs due to timeout or fast retransmission, and, if the latter, whether the plot indicates that the sender also used fast recovery.

   Include copies of your plots with your answers.

   (a) `http://inst.eecs.berkeley.edu/%7Eee122/fa06/hw/hw4-trace1.tcpdump`
   (b) `http://inst.eecs.berkeley.edu/%7Eee122/fa06/hw/hw4-trace2.tcpdump`
   (c) `http://inst.eecs.berkeley.edu/%7Eee122/fa06/hw/hw4-trace3.tcpdump`

8. **Extra credit.**

   Each of the following two traces:

   (a) `http://inst.eecs.berkeley.edu/%7Eee122/fa06/hw/hw4-trace4.tcpdump`
   (b) `http://inst.eecs.berkeley.edu/%7Eee122/fa06/hw/hw4-trace5.tcpdump`

   contains a significant error. In one case, the error is in terms of one of the TCP sender's algorithms; in the other case, it is a measurement error.

   Construct time-sequence plots of each and identify the error. (You can just do one of the traces for partial extra credit.)

Submission Instructions

Submit as usual via:

1. Log in to your instructional account.
2. Create a directory called "hw4" : **mkdir hw4**
3. Change to that directory: **cd hw4**
4. Copy all the files that you wish to submit to this directory.
5. Run the submit program: **submit hw4**