

CSE 677: Homework 1

(Due Date: Oct 10, Monday, Total: 40 points)

(Revised: Oct 1st)

1. **(0 point)** Read Chapter 1.
2. **(6 points)** A client is fetching a base html file with k referenced objects ($k \geq 0$) from an Internet server. Let the RTT be r . Assume that the transmission/reception time for each file and referenced objects, if any, is d . Further, the only transmission/reception bottleneck in the network is the access link through which the client is connected to the Internet. In terms of r , k , and d , compute the following delay for the following scenarios:
 - (a) non-persistent HTTP with parallel TCP connections. (no limit on the number of parallel connections)
 - (b) non-persistent HTTP with no parallel TCP connections.
 - (c) persistent HTTP with pipelining.
 - (d) persistent HTTP without pipelining.
3. **(4 points)** Suppose two hosts, A and B, are separated by 10,000 kilometers and are connected by a direct link of $R = 1$ Mbps. Suppose the propagation speed over the link is 2.5×10^8 meters/sec. What is the width (in meters) of a bit? (1Mbps = 10^6 bits per second)
4. **(5 points)** Suppose N packets arrive at a rate of S packets/second (with uniform spacing between packets) to a link at which no packets are currently being transmitted or queued. Each packet is of length L and the link has transmission rate R , where $R = S/2$ packets/second (Note that the unit is not bits-per-second). What is the average queuing delay for the N packets? Assume that the node has an infinite size packet buffer. (Hint: The first packet has a delay of 0. When the second packet arrives part of first packet has already been transmitted. First, compute the delay for each packet.)
5. **(7 points)** Consider sending a large amount of data over a lossy link. Each bit can be independently in error with a probability of b . Packets with any bit (data or header) in error is dropped by the receiver. Each packet contains an h bit header and a d bit data payload. The raw capacity of the link is C bits per second.
 - (a) (2 points) What is the probability that a packet gets dropped at the receiver?
 - (b) (2 points) Compute the throughput over the link. Throughput is defined as the maximum number of data bits received per second by the application. Assume that the sender is sending packets back-to-back.
 - (c) (3 points) Assume $h = 100$, and $b = 10^{-5}$. What is the value of d that maximizes the throughput over the link? You cannot use a program to find the answer. Use function optimization techniques, and show your work.
6. **(2 points)** Read about the WiMAX and WiFi technologies. What are the key differences between the two technologies? Do you think these technologies will co-exist in the future or will one of them replace the other? Comment with reasons.
7. **(8 points)** Read the man pages for `nslookup(1M)`. If you are not very familiar with UNIX man pages, start with `man man`. For parts (b), (c) and (d), also describe the commands you use to obtain the answers.

- (a) Read the man page for `resolv.conf`. Explain the contents of the `/etc/resolv.conf` file on the `stdsun` machine. What is the advantage of having multiple name servers as opposed to a single name server listed in this file?
 - (b) What are the canonical names of the machine `www.cnn.com` and `www.yahoo.com`.
 - (c) What is the name and the IP address of the machine on which the email server for the following recipients is running: `prasun@cse.ohio-state.edu` and `edspace@nasa.gov`? (If there are several mail server machines, provide information on only one).
 - (d) What are the names and IP addresses of the authoritative name servers for the following machines: `www.cs.duke.edu` and `setiathome.ssl.berkeley.edu`?
8. (8 points) Perform *Traceroute* from `stdsun` to any destination in Europe at two different hours of the same day.
- (a) (2 points) Submit a printout of the two traceroute operations.
 - (b) (2 point) Find the average of the round trip delays for the two hours. Each traceroute operation itself generates three round trip delays for the destination which is available in the last line after traceroute finishes its operation. Take the average of those three numbers to represent the delay at that hour.
 - (c) (2 points) Find the number of routers on the path for both the traceroute operations. Did the paths change during those two experiments?
 - (d) (2 points) Try to identify the number of ISP networks that the Traceroute packets pass through from source to destination. Routers with similar names and/or similar IP addresses could be considered as part of the same ISP. In your experiments, do the largest delays occur at the peering interfaces between ISPs?