HW #1

ELEN E6761 - Computer Communication Networks — Due 9/22/2000, 5pm
Fall 2000 — Prof. Rubenstein

Please turn your homework into Vassilis Stachtos' mailbox, E2 (oustide of the Electrical Engineering office, or fax it by 5pm. On-campus students can fax to Professor Rubenstein at (212) 932-9421 (remember to include your name and that the fax is for Professor Rubenstein). CVN students can fax as above, or fax to the CVN fax number. LATE ASSIGNMENTS WILL NOT BE ACCEPTED!! Note: don't wait until the last minute to fax - only one can go through at a time.

1. Why are the MAC (link layer) addresses fixed on the network card, whereas IP addresses must be assigned by a local administrator?

2. When is DHCP beneficial? Why isn't it always used to assign IP addresses to an interface?

3. Typically, a web browser provides a cache that caches web pages. This functionality could be incorporated into the DNS cache as well: rather than simply cache IP address-to-hostname mapping, the DNS cache could store the web-page and return the page upon receiving a request. Give three reasons why this is a bad idea.

4. Assume that the propagation delay between any pair of hosts, A and B (i.e., the time it takes a packet transmitted by A to reach B) is a constant, $C_{A,B}$. Also assume that the time to process a request is the same for a recursive query as it is for an iterated query. Also suppose that every DNS server X that would take a request from A (where A is either a host or another DNS server) and forward that request to B (either recursively or iteratively) knows $C_{A,B}, C_{B,A}, C_{A,X}, C_{X,A}, C_{X,B}$, and $C_{B,X}$. Describe the algorithm that X should use to determine whether to respond to A's request via an iterative or recursive query so that overall DNS query response times are minimized. Assume now that the a query from a host X_0 follows a fixed chain of DNS servers, $X_1, X_2, \cdots, X_n$ (i.e., for $1 \leq i < n$, each host X_i either makes a recursive request to X_{i+1}, or (for the iterative case), tells the host that contacted it [some X_j where $j < i$] where to send a request to X_{i+1}). Does the algorithm you proposed minimize overall DNS query response time. If so, prove the result. If not, give a counterexample.

5. Assume the same model as in problem 4, and also that for all pairs of hosts A, B, $C_{A,B} = C$, i.e., propagation delays between all pairs of hosts are the same. Why would iterative queries be better for this case?

6. Suppose a router (using CIDR) advertises the prefix $w.x.y.z/n$. Is there ever a reason that it would have also advertise $w.x.y.z/m$ where $m > n$? Explain.

7. Given the fact that bridges can be used to connect an unlimited number of hosts together, give two motivations for using routers in large-scale networks, even though they cost significantly more than bridges.

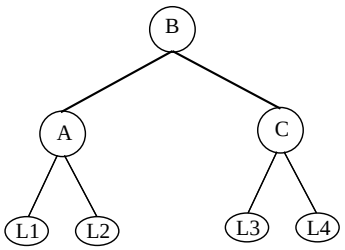

Figure 1:

8. You are designing a network with the topology given in Figure 1, where points A, B, C are ideal locations to place a bridge or a hub. $L1, L2, L3$, and $L4$ are LANs, each of contains 10 hosts. Assume (for simplicity) that transmissions by hosts are done on a round-by-round basis. On any given round, a host may attempt to transmit a frame to another host on any of the four LAN. Any frames that share a wire within a round will collide and cannot be received.

   Assume that in any given round, each host transmits with a probability of p, and that all hosts (on $L1, L2, L3, L4$) have the same likelihood of being the destination of a transmitted frame (i.e., the conditional probability that host y is the destination of a frame transmitted by host x given that host x transmitted a frame is $1/40$).

   Consider a given round and a given host x that lies on $L1$. Let T_x be a random variable that equals 1 if host x transmits a frame, and 0 otherwise. Let S_x be a random variable that equals 1 if host x successfully transmits a frame (i.e., there is), and 0 otherwise. Calculate $\Pr(S_x = 1 | T_x = 1)$ when

   (a) hubs are placed at A, B, and C.

   (b) a bridge is placed at A and hubs are placed at B and C.

   (c) a bridge is placed at B and hubs are placed at A and C.

   (d) a bridge is placed at C and hubs are placed at A and B.

   (e) bridges are placed at A and C and a hub is placed at B.

   (f) bridges are placed at A,B, and C.

   You may assume that the bridges' forwarding tables have stabilized (i.e., the bridge filters frames whenever possible).

   Hint: Let $q_0 = 1-p, q_1 = 1-p/4, q_2 = 1-p/2, q_3 = 1-3p/4$. Your solutions should easily be expressed as functions of q_0, q_1, q_2, and q_3.

   Assume now that $p = 1/40$, and that bridges cost more than hubs. If you only had a single bridge, would you install it at B? Why or why not? Argue why this would be the case for any $0 < p < 1$.