CS 528: First Midterm (Fall’02)

Answer all problems. Your answers should be concise – short and to the point, but including the important technical issues. The exam is long, but not difficult – work fast. Clearly state any assumptions. Good luck!

**Problem 1:** (8 points) Given a communication line (e.g., a co-ax cable, fiber link or a phone line), Shannon’s theorem defines the limit on the achievable data rate on this link as a function of the available bandwidth and the Signal to noise ratio.

(a) (2 points) Intuitively, why does a higher signal to noise ratio allow more “information” to be carried?
(b) (6 points) For a given bandwidth and signal to noise ratio, what factors go into determining the actual data rate achieved on the line?

**Problem 2:** (10 points)

What is the CRC value for the message 110101011011 with a polynomial of 11001. Prove that this polynomial will catch all 1-bit errors.

**Problem 3:** (16 points) Provide a brief discussion/explanation of the following possibly false statements.

1. Error detection/ARQ becomes better than Forward Error correction as the quality of a link improves
2. Learning bridges are susceptible to the count to infinity problem
3. Go-Back-N is better than selective repeat for links that suffer bursty errors (many packets dropped in a row)
4. Virtual circuit switched networks are not susceptible to attacks such as source address spoofing

**Problem 4:** (18 points)

(a) Suppose that baseline drift is the only problem faced with encoding at the link layer. Suggest two encoding schemes that would target baseline drift without wasting more than 10% of the bandwidth.

(b) You are designing a large and growing company network (tens of machines, 10s of segments, multiple administrators). You have the option of building the network using routers or switches to connect the different segments. What are the differences between the approaches and the advantages/disadvantages of selecting either?

(c) Deflection routing (or hot potato routing) is a routing approach where a router bounces a packet to a less congested link (rather than overflowing its buffers and dropping it). More precisely, if the “next hop” link for a packet is congested, the router picks any less congested link other than the one the packet came in on and sends the packet on it. Is this preferable to discarding the packet? Why isn't hot potato routing a common approach on the Internet?

**Problem 5:** (15 points) Devise an extension to distance vector that uses timestamps (or counters) to reduce loops. If this is not possible, show why. You may use additional information as well. If it is possible, discuss its advantages and disadvantages. Does it eliminate all loops?

**Problem 6:** (15 points) In the discussion of the sliding window protocol we assumed that the link is dedicated to the two nodes that are communicating. Consider the problem of reliable transmission on a shared link such as Ethernet. Assume that collisions are detected and retried after a binary exponential backoff.

(a) (8 points) What are the implications on the design of the sliding window protocol? (what changes, what difficulties are introduced, can they be solved?). Use an example if necessary.

(b) (5 points) Would your answer be different for a reservation based protocol such as token ring?

(c) (2 points) What do you think Ethernet actually does?

**Problem 7:** (18 points)

(a) (3 points) The end to end paper argues for placing functionality higher in a layered system. The authors then argue that sometimes performance requires pushing the functionality lower. If not for performance, what is the author’s motivation for pushing the functionality higher?

(b) (5 points) What factors may allow performance to be better at a higher level? Discuss using an example.

(c) (10 points) In the Tussle paper the authors present a reality that seems to clash with the end to end principle. Comment on this statement and suggest an updated form of the end to end argument (this may or may not be the same form that the author’s suggested). What is the goal of this updated principle?