

Exam 1 (Midterm), Fall 1999
Computer Science 416
Computer Communication Networks
University at Albany

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1 Some Hints

Your professor suggests the following preparation strategies:

- This exam is open book and open notes (your own books and notes that is!). Calculators are permitted, networked devices are not.
- Write neat clean answers, since if the grader cannot understand you on the real exam, it will go badly for you.
- Show your work, if you are guessing the grader will not give much credit (even if you get lucky and guess right).
- Define your notation (you can use tables like the lecture notes if you like).
- Set up the solution symbolically and simplify before plugging numbers in, it is easier to follow for the grader.
- You can solve problems out of order, but keep the work for each problem in one place, and mark it clearly.

2 The Problems

1. CRC (10 Points): Given a generator polynomial $P(x) = x^3 + x + 1$ and a message frame 101110, what is the corresponding CRC?
2. Signal Processing (15 points)
 - (a) Consider the network in Figure 1. Machine A sends a signal with 100 milliwatts of power. The link from machine A to machine B has 5 dB attenuation. Machine B amplifies its input by 2 dB during transmission along the link from B to C .

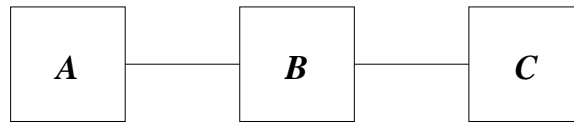


Figure 1: Network in Problem 2(a)i.

- i. (5 points) What is the total attenuation of a signal sent from A to C ?
 - ii. (5 points) What is the power of the signal arriving at C ?
- (b) (5 points) The ascii encoding of the letter 'z' is 0x7a (hexadecimal). Draw the unipolar and bipolar encoding of this character assuming that the set of valid voltages is $\{-V, 0, +V\}$ and one byte takes T units of time to transmit.
3. Channel Performance Analysis (20 points): Suppose you are a developer and you want to upgrade a remote software installation as soon as possible, and it is now 2 p.m. The upgrade requires transferring 10 gigabytes of programs and data to your customer's machine. You can send the data over a 10 Mbps network, but you only get 10% of that bandwidth on average. Otherwise, you could transfer the data to a tape and have an overnight delivery arrive at the customer site by 9:00 A. M. tomorrow. It takes an additional hour to read the tape into the customer's machine after it arrives. You can assume you and your customer are in the same time zone. Which solution will get your customer up and running faster, the overnight delivery service, or sending the files over the wire.
 4. ATM (10 Points): Recall that voice is sampled by telephone networks at 64 kbps.
 - (a) (5 points) Assuming that the cost of putting the values in a cell, adding a header and handing the packet off to the network are negligible. Derive the packetization delay for a 48 byte cell (and show your work)!

- (b) (5 points) Suppose that it took 1 msec to hand off a packet to the network. Also assume that adding a header and putting the values in the cell take negligible time. Then what would be the packetization delay if 32 byte cells were used?
5. Protocol Layering (20 points):
- (a) (5 points) How is randomization used in ethernet protocols (at the data link layer), and how do token ring networks avoid randomization?
- (b) (5 points) What services does the network layer provide?
- (c) (10 Points) Show the PPP frame containing the following C literal as the data sent using the IP protocol
- ```
"I aced 0x7e this 0x7d test!"
```
- Where 0x7e and 0x7d are the corresponding byte values injected into the stream of text.
6. Design principles and Queueing Theory (10 points): Suppose that a network interface card (NIC) implements the IP layer of the TCP/IP protocol in hardware (using a dedicated processor). Assume that when a packet is received it takes  $5\mu\text{sec}$  (on average) to process the headers and trailers of received packets at the IP layer, and  $12\mu\text{sec}$  (on average) for the software drivers to process the headers for the host to host layer.
- (a) (5 points) What is the maximum throughput of this system for received data if both the NIC hardware and host-to-host software can process packets in constant time?
- (b) If packets arrive every  $20\mu\text{sec}$  on average (exponentially distributed), and the IP and host-to-host layers have an exponential distribution?
7. Network Systems programming (15 points):
- (a) (10 points) Why do many flavors of unix support scatter/gather programming using `readv` and `writev` systems calls?
- (b) (5 points) What functionality does the `bind` system call provide?