EECS 122 : Introduction to Communication Networks

Spring 2004

Assignment 2

Due: February 13, 2004

Problem 1 [10 Pts]

Peterson and Davie, Chapter 2, Exercise 6.

Problem 2 [15 Pts]

Peterson and Davie, Chapter 2, Exercise 10.

Problem 3 [20 Pts]

(a) Peterson and Davie, Chapter 2, Exercise 11.

(b) Peterson and Davie, Chapter 2, Exercise 12.

(c) Peterson and Davie, Chapter 2, Exercise 13.

Problem 4 [10 Pts]

Peterson and Davie, Chapter 2, Exercise 43.

Problem 5 [20 Pts]

Peterson and Davie, Chapter 2, Exercise 44.

Problem 6 [10 Pts]

Consider the case of GSM cell phones. GSM operates at 270.88 kbps and uses a spectrum spanning 200 kHz. What is the theoretical SNR (in dB) that these phones need for operation.

In reality, the phones use a SNR of 10 dB. Use Shannon's theorem to calculate the theoretical capacity of the channel, under this signal-to-noise ratio. How does the utilized capacity compare with the theoretical capacity.

Problem 7 [15 Pts]

Consider a random access MAC protocol like Slotted ALOHA. Quick summary: There are N nodes sharing a media, and time is divided into slots. Each packet takes up a single slot. If a node has a packet to send, it always tries to send it out with a given probability. A transmission succeeds if a single node is trying to access the media and all other nodes are silent.

(a) Suppose that we want to give differentiated services to these nodes. We want different nodes to get a different share of the media. The scheme we choose works as follows: If node i has a packet to send, it will try to send the packet with probability p_i. Assume that every node has a packet to send all the time. In such a situation, will the nodes indeed get a share of the media in the ratio of their probability of access ?

(b) Lets put numbers on that. Suppose there are 5 nodes, and the respective probabilities are $p_1 = 0.1$, $p_2 = 0.1$, $p_3 = 0.2$, $p_4 = 0.2$ and $p_5 = 0.3$. On an average, what are the probabilities that each node is able to transmit successfully, in a given time slot.

(c) Now suppose that nodes do not always have a packet to send. In fact, the percentage of time slots when a node has a packet to send (call it busy time b_i) is the same as its probability of access, i.e. $b_i = p_i$. For simplicity's sake, do not consider any queuing or storing of packets – only that node i has a packet to send on b_i of the slots. In such a situation, is the share of each node in the correct proportion of their access probability, or busy time ?