CS/ECE 707 Mobile and Wireless Networking **Fall 2007**

Mid-term Exam I

Open book and notes; Take home *Due: Friday, November 2, 2007*

⊕ *Please submit a printed version of your answers. Do not forget to write your name on the first page. Please staple multiple pages together.*
⊕ ⊕ **Be precise**. *If you have written something incorrect along with the correct answer, you should* **not** *expect to get all the points. I will grade based upon what you* **wrote**, *not what you* **meant**.
⊕ *You should draw simple figures if you think it will make your answers clearer.*
⊕ *Good luck and remember, brevity is the soul of wit.*

Name: _____

Your goal is to design a joint data rate and power control algorithm for the 802.11 wireless MAC. The first two questions will help in increasing the understanding of the design space. The third question will be the actual design.

1. Consider two wireless links ($A \rightarrow B$) and ($C \rightarrow D$). Let us assume that each of these nodes can transmit with some power, p, in the range 0 to $p_{\max}$ and some transmission rate, r, in the range 0 to $r_{\max}$. Let the bit error rate, b be proportional to $r.e^{-\mathrm{SNR}^2}$, where SNR (Signal to Noise Ratio) is defined in the usual way. Let the distance between each transmitter receiver pair be, d, and the distance between the two link pairs be D. A signal transmitted with power p is received at a distance d, with power, $p.x^{-2}$.

   The throughput corresponding of transmissions at rate r and bit error rate, b, is proportional to $r(1-b)$. Calculate the optimal choice of transmission power and data rate for these two links.

   You can use some numerical values (of $p_{\max}$ and $r_{\max}$) to test out your hypothesis. (5 points)

2. In the above example, if your goal is to maximize throughput normalized against transmit power, i.e., maximize $r(1-b)/p$, how should transmit power and data rates be chosen. Again, use some numerical examples to test our your solution. (5 points)

3. Design a joint power control and rate control algorithm along the lines of PCMA. You should make the same assumptions as PCMA, i.e., there is a busy tone on which you can send out noise tolerance level. Essentially, your goal is to extend the basic design of PCMA to include rate information, with the overall informal goal of maximizing throughput for new communicating node pairs while keeping the cooperation principle in mind. Note that the power conserving principle is no longer an explicit goal, since this might lead to poor throughputs.

   You need to explain your design choice, and present some analysis as to why different parameters have been chosen the way they have.

   You do not need to repeat anything that is exactly identical to PCMA. Focus on how rate choices are being made. (10 points)