

EE 6950 – Homework #3  
Assigned: 11/17/03; Due: 11/24/03 before class  
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1. Consider two nodes connected by an IEEE 802.11b 11 Mbps wireless link. Assuming that the wireless link is collision and error-free, calculate the maximum user throughput over this wireless link, when UDP is used with payloads of 100, 500, and 1500 bytes. Assume RTS/CTS is not enabled on this link. IEEE 802.11b protocol parameters are as follows: PLCP preamble and header is 24 bytes, MAC/LLC header and trailer (FCS) length is 42 bytes, ACK is 14 bytes, SIFS is 10  $\mu$ s, DIFS is 50 $\mu$ s and average backoff time between transmissions is 310 $\mu$ s (on average, Minimum Contention Window time/2). Note that PLCP and control packets are always transmitted at 1Mbps. (50 pts).
2. Consider the following Mobile IP network: 300-users/sq. mile, FA covers a square region of 10 sq. miles, the average velocity is 10 miles/hour, and the binding lifetime is 5 minutes. What is the percent of registrations due to mobility (assume that the binding lifetime is not reset when a mobile host registers due to movement)? (25 pts)
3. Consider a voice-over-IP system that transmits 64Kbits/s PCM voice using RTP/UDP/IP with a packetization interval of 20ms, i.e. a 20ms voice sample is placed in an IP packet. How many such streams can be transmitted over a 10Mbps Ethernet link (MAC header and trailer length is 18 bytes) assuming the link can be loaded up to 80%? What is the maximum number of streams if packetization interval of 10ms was used? If these streams with a packetization interval of 10ms were transmitted to a mobile user using Mobile IP, what is the maximum number of streams over the same link when using a) IP in IP encapsulation, b) minimum encapsulation, and c) GRE encapsulation? Assume no extra options are enabled. (25 pts).