ee290q Wireless Sensor Networks, HW4

Due 3/12/09

1. If a burst of noise corrupts dozens of bits in the middle of an 802.15.4 packet, what is the probability that the error is undetected by
    a. CRC-16
    b. MIC-32
    c. CRC-16 and MIC-32
2. Assume that there are two separate 1000-node networks in a building running with the same network ID, and each mote sends on-average one packet every second, and each mote can hear on-average 10 motes from the other network. Both networks properly calculate their FCS, and both use a 32-bit MIC, but with different keys. How often will a mote from one network incorrectly accept a packet from the other network (i.e. how often will the MIC be the same)?
3. Calculate the effective G for a mote sending one maximum-length acknowledged 2.4GHz 802.15.4 packet per second. Assume the TX/RX turnaround is the 15.4 specified 0.192ms, and a 30B ACK.
    a. What is the peak number of packets per second that can be delivered to an access point assuming pure Aloha statistics.
4. In an Aloha network with 10% goodput,
    a. What is the offered load, and what fraction of that is retries?
    b. If congestion occurs, and the network ends up operating on the far side of the peak (G>0.5), how many times is each packet sent on average before it is successfully delivered?
5. In Abramson's 1970 paper on Aloha, he calculates the maximum number of users of his system as 324 (eqn 3). If we take his assumption for the generation rate as valid, do you agree with his conclusion?
6. Generate a random connected 2D array of motes with the Hack Model for connectivity. For two motes A and B which can both hear mote C, calculate the probability that mote A can hear mote B. (If you can do this analytically, let me know!) What does this mean about the hidden terminal problem (common, rare, unimportant, …)?
7. Use matlab to simulate two motes, A and B, which can't hear each other but can both talk to C. Plot their queue size and packet error rates vs. time for different generation rates on each mote. How close can you get to 1/2e?
8. In the 802.15.4-2006 standard, refer to figure 69 and estimate the average and worst-case latency due to CSMA backoff for a link with 100% PDR, 90% PDR, and 50% PDR. You may find Tables 85 and 86 useful for constants, like aUnitBackoffPeriod.
9. Consider the 802.15.4 backoff strategy for non-ACKnowledge frames (7.5.6.4.3) with 100% PDR when there is no channel contention. Is this likely to work well with hidden terminals? What will happen?