

CSE P561: Network Systems  
Homework #1  
Due: Start of class, week 4

1. In class, we mentioned that the received power level in radio transmission is often proportional to  $d^{-k}$ ,  $d$  the distance to the sender, and  $k \leq 2$ , with  $k$  a small value as a function of the environment. Using Shannon's theorem, write a formula bounding the data rate as a function of  $k$  and  $d$ .
2. Explain why the packet error rate from a sender to a receiver may not be the same as in the opposite direction.
3. Carrier sense can prevent one send from trampling on top of another, but it is imprecise because the power level is sensed at the sender, but the interference happens at the receiver. One way to address this would be for a sender to listen to the source and destination of packets as they are transmitted, and only send a new packet if it wouldn't interfere with the concurrent transmission at either receiver. Explain how these conflict maps might be created. Under what circumstances would the mechanism fail to work as intended?
4. Ethernets use Manchester encoding. Why does this allow for collisions to be detected soon after they occur, without waiting for the CRC to be computed at the end of the packet?
5. Two professors, Alice and Bob, are scheduled to teach a class to a group of cannibals. Unfortunately, distance learning hasn't been invented yet, so they need to teach in person. They are justifiably afraid of the students, but if both of them show up to class, they feel sure they will be able to defend themselves against the students. Each would like to show up to teach, but only if the other is definitely going to come to class. Alice and Bob can only communicate with each other via email, and each has a hungry spam filter that eats lots of real messages, so it is not assured that an email sent will be received. Alice sends an email to Bob that says "Are you definitely coming to class on Tuesday? I will show up if I know you will show up". Bob receives that email and sends "I will come to class provided that I know you are coming also". At this point, do both Alice and Bob know that it is safe to show up to class? If not, then how many more messages (and what would they be) would be needed to be added to this exchange, in order for Alice and Bob to both know that it is safe to show up?