Assignment #2 (5% with 1% Bonus Point)

CS5263 Wireless Multimedia Networking Technologies and Applications
Department of Computer Science, National Tsing Hua University Hsin Chu, Taiwan

Please attach additional sheets and clearly mark the question numbers. Due at 3:30 p.m. on October 28th, 2013. Please turn in hardcopies before the lecture starts. See course website for grading policies, especially about late submissions.

1) (1%) Is the 3G wireless service available in Taiwan? How is it priced? What applications are being supported[1]?

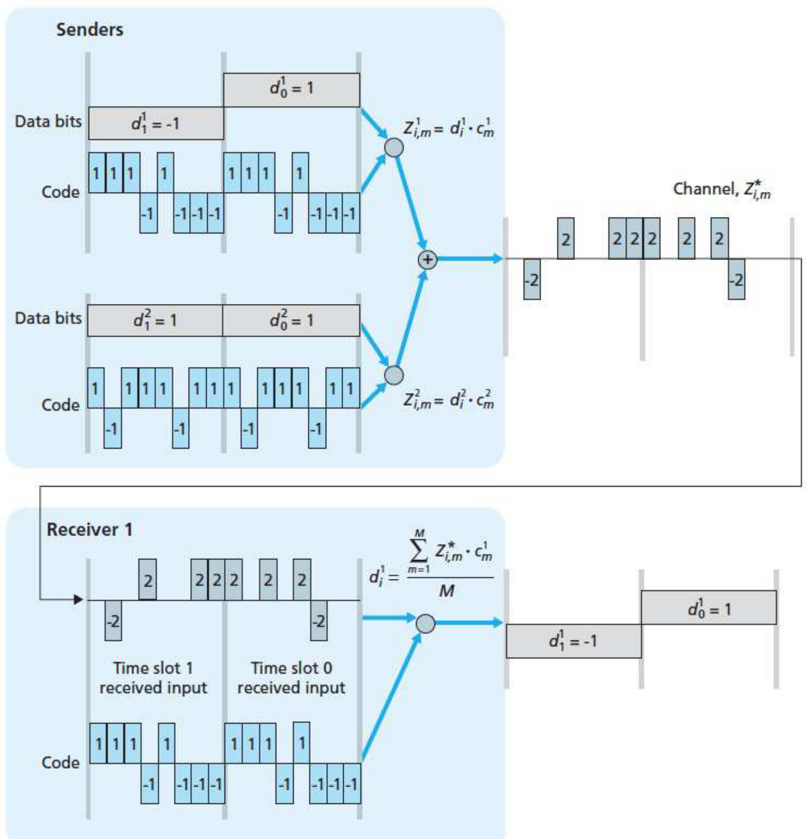

Fig. 1

2) (1%) Suppose that the receiver in Figure 1 wants to receive the data being sent by sender 2. Demonstrate (in math) that the receiver is indeed able to recover sender 2's data from the aggregate channel signal by using sender 2's code.
3) (1%) Suppose an 802.11b station is configured to always reserve the channel with the RTS/CTS sequence. Suppose this station suddenly wants to transmit 1,000 bytes of data, and all other stations are idle at this time. As a function of SIFS and DIFS, and ignoring propagation delay and assuming no bit errors, calculate the time required to transmit the frame and receive the acknowledgment.

[1]You are encouraged to discuss with each other, but the eventual writeup should be your own!

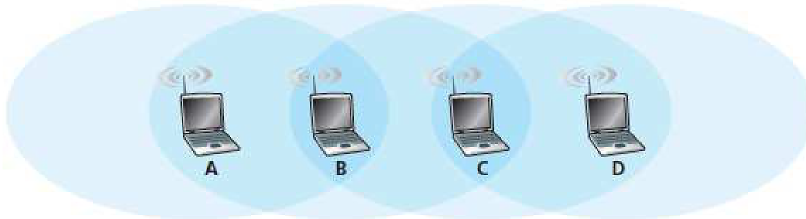

Fig. 2

4) (3%) Consider the scenario shown in Figure 2, in which there are four wireless nodes, A, B, C, and D. The radio coverage of the four nodes is shown via the shaded ovals; all nodes share the same frequency. When A transmits, it can only be heard/received by B; when B transmits, both A and C can hear/receive from B; when C transmits, both B and D can hear/receive from C; when D transmits, only C can hear/receive from D. Suppose now that each node has an infinite supply of messages that it wants to send to each of the other nodes. If a message's destination is not an immediate neighbor, then the message must be relayed. For example, if A wants to send to D, a message from A must first be sent to B, which then sends the message to C, which then sends the message to D. Time is slotted, with a message transmission time taking exactly one time slot, e.g., as in slotted Aloha. During a slot, a node can do one of the following: (i) send a message; (ii) receive a message (if exactly one message is being sent to it), (iii) remain silent. As always, if a node hears two or more simultaneous transmissions, a collision occurs and none of the transmitted messages are received successfully. You can assume here that there are no bit-level errors, and thus if exactly one message is sent, it will be received correctly by those within the transmission radius of the sender.
   a) (0.34%) Suppose now that an omniscient controller (i.e., a controller that knows the state of every node in the network) can command each node to do whatever it (the omniscient controller) wishes, i.e., to send a message, to receive a message, or to remain silent. Given this omniscient controller, what is the maximum rate at which a data message can be transferred from C to A, given that there are no other messages between any other source/destination pairs?
   b) (0.34%) Suppose now that A sends messages to B, and D sends messages to C. What is the combined maximum rate at which data messages can flow from A to B and from D to C?
   c) (0.34%) Suppose now that A sends messages to B, and C sends messages to D. What is the combined maximum rate at which data messages can flow from A to B and from C to D?
   d) (0.99%) Suppose now that the wireless links are replaced by wired links. Repeat questions (a) through (c) again in this wired scenario.
   e) (0.99%) Now suppose we are again in the wireless scenario, and that for every data message sent from source to destination, the destination will send an ACK message back to the source (e.g., as in TCP). Also suppose that each ACK message take up one slot. Repeat questions (a) (c) above for this scenario.