Home Page: http://www.public.asu.edu/~bhao2

Homework 6

Problems:

1, 3, 5, 8.

Question: 1

Consider the single-sender CDMA example in Figure 6.5. What would be the sender's output (for the 2 data bits shown) if the sender's CDMA code were (1, –1, 1, –1, 1, –1, 1, –1)?

Answer:

(-1, 1, -1, 1, -1, 1, -1, 1, 1, -1, 1, -1, 1, -1, 1, -1)

Question: 3

Suppose that the receiver in Figure 6.6 wanted to receive the data being sent by sender 2. Show (by calculation) that the receiver is indeed able to recover sender 2's data from the aggregate channel signal by using sender 2's code.

Answer:

$$d_2^1 = \frac{1*1+(-1)*(-1)+1*1+1*1+1*1+(-1)*(-1)+1*1+1*1}{8} = \frac{8}{8} = 1$$

$$d_2^2 = \frac{1*1+(-1)*(-1)+1*1+1*1+1*1+(-1)*(-1)+1*1+1*1}{8} = \frac{8}{8} = 1$$

Question: 5

Suppose there are two ISPs providing WiFi access in a particular café, with each ISP operating its own AP and having its own IP address block.

a. Further suppose that by accident, each ISP has configured its AP to operate over channel 11. Will the 802.11 protocol completely break down in this situation? Discuss what happens when two stations, each associated with a different ISP, attempt to transmit at the same time.

b. Now suppose that one AP operates over channel 1 and the other over channel 11. How do your answers change?

Answer:

a. No, 802.11 will not completely break down since the MAC and SSID of every AP is different. For example, a host using 802.11 could send data to multi Aps, but only the AP with correct MAC will process the data. However, this situation will reduce the communication performance if many Aps using the same wireless channel.
b. Using different wireless channel will improve the performance by reducing the possibility of data collision.

Question: 8

Consider the scenario shown in Figure 6.33, 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. 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?

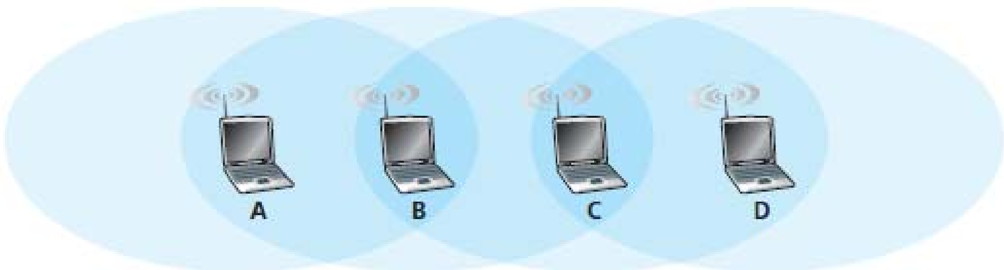

Figure 6.33 ♦ Scenario for problem P8

b. 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. 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. Suppose now that the wireless links are replaced by wired links. Repeat questions (a) through (c) again in this wired scenario.

e. 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 takes up one slot. Repeat questions (a) – (c) above for this scenario.

Answer:

a. A: 1 message per 4 slots
   B: 1 message per 2 slots (C controls B for maximum rate)
   C: 1 message per slot
   D: 2 messages per slot

b. A: 1 message per 4 slots
   B: 1 message per 2 slots
   C: 1 message per slot
   D: 2 messages per slot (ANS)

c. A: 1 message per 4 slots
   B: 1 message per 2 slots
   C: 1 message per slot (ANS)
   D: 2 message per slot

d. A: 1 message per 4 slots
   B: 1 message per 2 slots
   C: 1 message per slot (ANS to a)
   D: 2 message per slot (ANS to b abd c)

e. A: 1 message per 4 slots (ANS to a)
   B: 1 message per 2 slots
   C: 2 messages per 3 slots (ANS to b and c)
   D: 1 message per slot