Problem 4

Sender 1: (1, 1, 1, -1, 1, -1, -1, -1)
Sender 2: (1, -1, 1, 1, 1, 1, 1, 1)

Problem 5

a) The two APs will typically have different SSIDs and MAC addresses. A wireless station arriving to the café will associate with one of the SSIDs (that is, one of the APs). After association, there is a virtual link between the new station and the AP. Label the APs AP1 and AP2. Suppose the new station associates with AP1. When the new station sends a frame, it will be addressed to AP1. Although AP2 will also receive the frame, it will not process the frame because the frame is not addressed to it. Thus, the two ISPs can work in parallel over the same channel. However, the two ISPs will be sharing the same wireless bandwidth. If wireless stations in different ISPs transmit at the same time, there will be a collision. For 802.11b, the maximum aggregate transmission rate for the two ISPs is 11 Mbps.

b) Now if two wireless stations in different ISPs (and hence different channels) transmit at the same time, there will not be a collision. Thus, the maximum aggregate transmission rate for the two ISPs is 22 Mbps for 802.11b.

Problem 6

Suppose that wireless station H1 has 1000 long frames to transmit. (H1 may be an AP that is forwarding an MP3 to some other wireless station.) Suppose initially H1 is the only station that wants to transmit, but that while half-way through transmitting its first frame, H2 wants to transmit a frame. For simplicity, also suppose every station can hear every other station's signal (that is, no hidden terminals). Before transmitting, H2 will sense that the channel is busy, and therefore choose a random backoff value.

Now suppose that after sending its first frame, H1 returns to step 1; that is, it waits a short period of times (DIFS) and then starts to transmit the second frame. H1's second frame will then be transmitted while H2 is stuck in backoff, waiting for an idle channel. Thus, H1 should get to transmit all of its 1000 frames before H2 has a chance to access the channel. On the other hand, if H1 goes to step 2 after transmitting a frame, then it too chooses a random backoff value, the Thus, fairness was the rationale
behind this design choice.

Problem 7

A frame without data is 32 bytes long. Assuming a transmission rate of 11 Mbps, the time to transmit a control frame (such as an RTS frame, a CTS frame, or an ACK frame) is (256 bits)/(11 Mbps) = 23 usec. The time required to transmit the data frame is (12384 bits)/(11 Mbps) = 1125.82

DIFS + RTS + SIFS + CTS + SIFS + FRAME + SIFS + ACK
= DIFS + 3SIFS + (3*23 + 1125.82) usec = DIFS + 3SIFS + 1194.82 usec

Problem 8

a) 1 message/ 2 slots

b) 2 messages/slot

c) 1 message/slot

d) i) 1 message/slot

   ii) 2 messages/slot

   iii) 2 messages/slot

e) i) 1 message/4 slots

   ii) slot 1: Message A→ B, message D→ C

   slot 2: Ack B→ A

   slot 3: Ack C→ D

   = 2 messages/ 3 slots

   iii)

   slot 1: Message C→ D

   slot 2: Ack D→C, message A→ B

   slot 3: Ack B→ A

   Repeat

   = 2 messages/3 slots