NTNU
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TTM4100
Communication – Services and Networks

Assignment for Chapter 6: "Wireless and Mobile Networks"

Deadline of submission: **19.03.2017**

The assignment questions are selected from the Review Questions and Problems of Chapter 6 in the textbook: J. F. Kurose and K. W. Ross. *Computer Networking: A Top-Down Approach (International Edition, sixth edition)*. Please note that there are modifications to the questions in the textbook, the questions in this document are to be used if there are differences.

The following selected questions should be answered and the answers should be submitted to the Its Learning System. For these selected questions, two or more choices are provided for each of their sub-questions, and one of them is correct.

1. Consider the scenario shown in Figure 6.33 below 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.

Figure 6.33 ♦ Scenario for problem P8

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 transmission, 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. (Problem P8, Chapter 6, page 581.**)**

1.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? *(P8.a)*

1.a.1 1 message/4 slots
1.a.2 1 message/2 slots
1.a.3 1 message/slot
1.a.4 2 messages/slot

1.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? (*P8.b****)***

1.b.1 1 message/4 slots
1.b.2 1 message/2 slots
1.b.3 1 message/slot
1.b.4 2 messages/slot

1.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? (*P8.c****)***

1.b.1 1 message/4 slots
1.c.2 1 message/2 slots
1.c.3 1 message/slot
1.c.4 2 messages/slot

1.d) Suppose now that the wireless links are replaced by wired links. Repeat questions (1.a)-(1.c) again in this wired scenario. (*P8.d****)***

1.d.a

1.d.a.1 1 message/4 slots
1.d.a.2 1 message/2 slots
1.d.a.3 1 message/slot
1.d.a.4 2 messages/slot

1.d.b

1.d.b.1 1 message/4 slots
1.d.b.2 1 message/2 slots
1.d.b.3 1 message/slot
1.d.b.4 2 messages/slot

1.d.c

1.d.c.1 1 message/4 slots
1.d.c.2 1 message/2 slots
1.d.c.3 1 message/slot
1.d.c.4 2 messages/slot

1.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). Repeat questions (1.a)-(1.c) above for this scenario. *(P8.e)*

1.e.a

1.e.a.1	1 message/4 slots
1.e.a.2	1 message/2 slots
1.e.a.3	2 messages/ 3 slots
1.e.a.4	1 message/slot

1.e.b

1.e.b.1	1 message/4 slots
1.e.b.2	1 message/2 slots
1.e.b.3	2 messages/ 3 slots
1.e.b.4	1 message/slot

1.e.c

1.e.c.1	1 message/4 slots
1.e.c.2	1 message/2 slots
1.e.c.3	2 messages/ 3 slots
1.e.c.4	1 message/slot

3. Suppose an 802.11b station is configured to always reserve the channel with the RTS/CTS sequence. Suppose this station suddenly wants to transmit 2,000 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. *(A frame without data is 32 bytes long. Assume a transmission rate of 11 Mbps. Assume no fragmentation in transmitting the data.)* (Problem P7, Chapter 6, page 581.**)**

3.a DIFS + SIFS + 182 μs
3.b DIFS + 2SIFS + 182 μs
3.c DIFS + 2SIFS + 1455 μs
3.d DIFS + 3SIFS + 1547 μs

4. 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. (Problem P5, Chapter 6, page 580)

4.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? (First part of Problem 5.a, Chapter 6, page 580)

4.a No, as there are 2 APs with different IP address blocks, it will work without problems.
4.b No, but wireless stations will associate to both APs at the same time, using both to connect to the Internet.
4.c Yes, because the channel is used to address the frames, it will be impossible to distinguish to which wireless station/AP a frame is addressed to.
4.d Yes, APs will detect the channel is already in use and both will ignore any frame associated to that channel.
4.e No, but if wireless stations in different APs send at the same time, there will be a collision.