

Homework 3, 2020

Name: _____

Student ID: _____

Notes:

1. Be **brief** and **concise** in your answers.
2. If you wish to be considered for partial credit, show all your work.
3. You are expected to uphold the highest degree of academic honesty.

PROBLEM	MAX SCORE	YOUR SCORE
1	24	
2	30	
3	14	
4	20	
5	12	
TOTAL	100	

YOU ARE EXPECTED TO WORK ON IT INDEPENDENTLY !!

Problem 1 (24 points): Multiple choices (3 points each). Select all correct answers from the given five choices (there *may* be multiple correct answers).

1. Which is not a characteristic of wireless transmissions?
 - Your answer ____ (A) multipath fading; (B) location-dependent contention; (C) signal attenuation over distance; (D) the same rate perceived at different receivers.
2. Which packet does NOT contain the NAV (network allocation vector) in 802.11 DCF?
 - Your answer ____ (A) RTS; (B) CTS; (C) DATA; (D) ACK; (E) beacons.
3. In a given wireless networking scenario, if we know that hidden/exposed station effect between nodes is negligible, but the data corruption rate is significant, then which signaling or control component in MACAW can be eliminated?
 - Your answer ____ (A) RTS (B) CTS (C) ACK (D) DATA
4. Your goal is to build a rate adaptation algorithm (i.e., adjusting transmission rate based on dynamic channel quality) for IEEE 802.11 wireless networks. Which of the following design guidelines/statements are correct?
 - Your answer ____ (A) In an interference-free environment high percentage of frame loss implies that the algorithm should switch to lower transmission rates. (B) High SNR with high percentage of frame loss at the receiver imply that there are hidden terminals and high interference. (C) High percentage of frame loss always implies that algorithm should switch to lower transmission rates. (D) the transmission rate which gives the highest throughput should be selected.
5. Which of the following statements about Mobile IP are true?
 - Your answer ____ (A) In TCP/IP, the host IP address is used for both IP routing and connection identifier. (B) Even you use mobile IP on each host, the standard TCP protocol still cannot run on the mobile host without any change. (C) The Mobile IP protocol needs the home agent for both Mobile IPv4 and IPv6. (D) When a mobile host is back to its home network from a foreign network, its home agent has to run proxy ARP to enable correct packet delivery.
6. Which of the following statements about IEEE 802.11 are False?
 - Your answer ____ (A) The standard can automatically switch between the PCF and the DCF mode. (B) In the power saving mode, the access point also powers off to save its energy. (C) The client has to initiate the handoff process (i.e., switch to a new AP from its old AP) in roaming. (D) Time synchronization relies on the periodically broadcasted beacons.
7. Which of the following statements about wireless packet scheduling are True?
 - Your answer ____ (A) Can handle bursty and location-dependent channel errors. (B) Aims to achieve instantaneous fairness. (C) Does not support distributed scheduling. (D) The scheduler of Weighted Fair Queue uses a real clock rather than virtual one.
8. Which of the following statements about Snoop are True?

- Your answer ____ (A) Can improve uplink throughput. (B) Can improve downlink throughput. (C) Support both TCP and UDP. (D) Split a TCP connection into two TCP connections.

Problem 2 (30 points; 6 points each): Answer the following questions. Be brief and concise.

1. Identify at least two solution techniques to recover from wireless transmission losses at the link layer.
2. A 2000-byte IP packet is to be transmitted in the 802.11 DCF mode. Assume that the user sets the maximum frame length as 1500 bytes, and the RTS/CTS turn-on threshold as 1200 bytes. Draw both the timing sequence (including all possible inter-frame spacings (IFS)) and all messages used during the packet transmission.
3. Assume that you are the operator of an 802.11 (DCF) wireless network that can be highly congested when a large number of users are contending for the channel. What modifications will you make on the protocols (MAC or higher layer) in order to handle the large user population?
4. Assume all 20 nodes are within the wireless communication range among one another (i.e., they can always hear each other's transmissions). Describe a solution to achieving fair channel access among the 10 pairs of node communications when they all have data to send. The solution has to be fully distributed! Each node cannot collect, store or use any states on other node pairs. (Hint: the second part of wireless packet scheduling)

5. Why does Snoop discard non-1st duplicate ACKs?

Problem 3: Reliable Transport Layer Design (14 points) You are asked to design a wireless TCP-like transport protocol for smartphones. The smartphone device has two wireless interfaces, one with as low as 20Kbps over GPRS of wide-area coverage, and the other with up to 54Mbps over 802.11g of small indoor coverage. You are asked to design a reliable transport protocol that works on *both* interfaces simultaneously. Assume that the current operational networks do not provide information feedback on the loss behaviors (e.g., ECN, or ELN).

1. (7 points) Your protocol will transmit data packets on both interfaces simultaneously. How do you handle out-of-order delivery due to different transmission speed and transfer paths over different wireless networks? (Hint: Mobility support at Transport Layer, Lecture 5)
2. (7 points) As the smartphone user roams between different spots even in the same building, (s)he also experiences constant disconnections and reconnections over the WiFi interface (but not the GPRS). The disconnection may last for 60 seconds at certain bad spots. Can you briefly describe how your protocol manages this disconnection and reconnection case? Note that prolonged disconnection may invoke the TCP's retransmission timer to increase its timeout value exponentially.

Problem 4: Mobile IP (20 points) Your laptop supports Mobile IP function. When you enter a visited network, your laptop will perform Mobile IP registration procedure. Please answer the following questions.

1. (5 points) How does your laptop discover a foreign agent in the visited network?

2. (5 points) Assume that adversaries can deploy a fake foreign agent in the visited network and broadcast fake agent advertisement messages. Does current agent discovery procedure defend against such attack (connecting with a rogue FA)? IF not, please design a mechanism to tackle this security threat.

3. (5 points) How does your Home Agent authenticate your laptop once it receives your Mobile IP registration request?

4. (5 points) Are there any security issues of current Mobile IPv4 user authentication mechanism? (Hint: hash function)

Problem 5: Cross-Layer Design (12 points) Assume that you are able to obtain all information from Wi-Fi physical layer and link layer. Please answer the following questions.

1. (6 points) Please develop a mechanism to leverage the information to improve the TCP performance.
2. (6 points) Please give an example showing that cross-layer design may lead to bad consequence (Hint: the reading assignments of Lecture 2).