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End Semester Examination
Wireless Networks CSE/ECE 538

Q1. Consider a transmitter (Tx) and receiver (Rx) communicating over a 80 MHz wireless channel. Answer the following questions

a. The transmit power of the sender is 1000 mW. Convert this value into units of dBm. [1]

b. The thermal noise on this channel is measured to be -100 dBm. Convert this value into units of watts. [1]

c. What is the SNR at the receiver if the transmitted signal suffers a path loss of 120 dB due to channel propagation effects? (Use the transmit power and noise values from (a) and (b)) [2]

d. What is the maximum rate at which information can be transmitted between this sender and receiver as per Shannon's capacity formula? [1]

e. If the receiver's sensitivity is -85dBm, will the receiver be able to receive the signal? [1]

f. Next, you are using OFDM for transmission which has 256 subcarriers of which 234 are data subcarriers, the guard band is 0.4us. Consider the table given and decide which MCS scheme you should use for efficient use of the channel [4]

0	BPSK	1/2
1	QPSK	1/2
2	QPSK	3/4
3	16-QAM	1/2
4	16-QAM	3/4
5	64-QAM	2/3
6	64-QAM	3/4
7	64-QAM	5/6
8	256-QAM	3/4
9	256-QAM	5/6

g. If the coherence BW of the channel is 200KHz, will there be ISI? [1]

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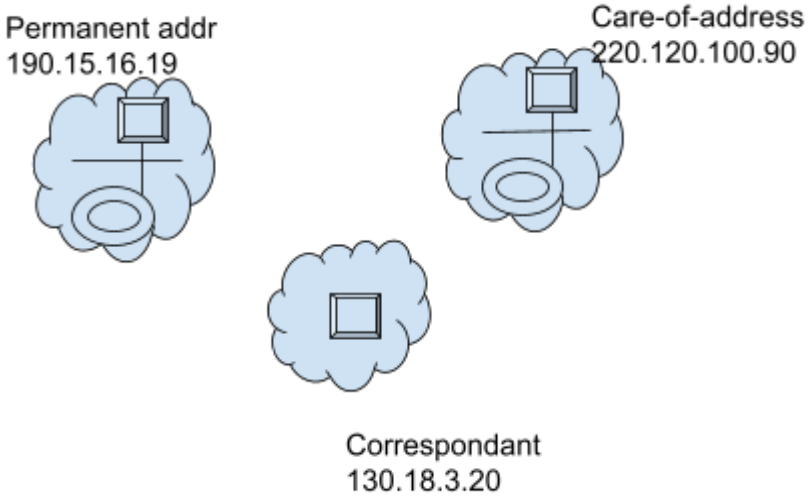
Q2. Consider the movement of the mobile from 190.15.16.19 to 220.120.100.90. Now suppose you are using mobile IP via indirect routing to handle mobility. [1+1]

a. Show the destination address of a packet sent by the correspondent.
b. Write the source address of a packet sent by the mobile.



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Q3. Continuing from previous question, suppose there is a middlebox at the foreign network. It performs ingress filtering if the IP does not belong to the network and does not allow data to flow from a TCP connection if there is no TCP handshake. [2 +2]

a. How to make the data flow in this case using network layer mobility solution only, which routing mechanism will be used here?
b. Suppose instead of handling mobility at the transport layer we decided to do it at the transport via the usage of MPTCP. How would the data flow in this case?

Q4. Remember that WiFi has power save in which clients can go to sleep to save power but wakes up to receive beacon frames. Beacon frames include a TIM map to tell whether it has packets buffered for the STA. If there are packets, the STA sends a PS-poll frame to receive. Now the nodes going into power save mode are IoT nodes and all the downlink data they receive are some common instructions. [2+ 2]

a. Suggest of an efficient way of disseminating this common info, explain your answer
b. The uplink data shared by the nodes are different. Suggest an efficient way of sending uplink data. Explain your answer.

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Q5. Consider the following topology, suppose CSMA/data transfer range of A, B, and C is 1 hop only. Suppose A wants to send a packet to B and C also wants to send a packet to B. Suppose, the DIFS value=28us, slottime=9us, data transfer takes 10 slot times and control packet transfer takes 1 slottime. Suppose, the first backoffcounter value for A is 3 and for B is 4. Will there be a collision here? How to allow efficient communication here, show via a timing diagram of communication. Assume whatever is not specified. [3]

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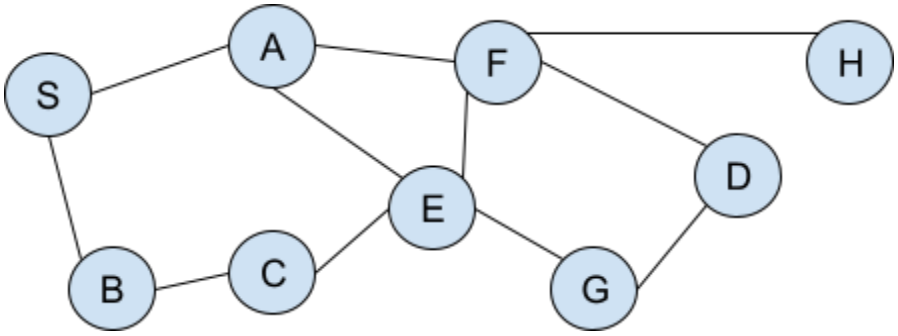
Q6. Consider the following multihop topology of 8 nodes,



S through D. Nodes that do not have a link between them are not within radio range of each other. The nodes use a DSDV like routing protocol. For the sake of simplicity, assume that D is the only possible destination in the routing and forwarding tables. For this destination D, each node maintains a set of routes, which are tuples of the form (next-hop, metric). The node then picks one of these routes as its best route, and periodically advertises it to neighbors using DSDV-like routing messages. For each case below, list all known routes (next-hop, metric) to the destination D at nodes **A, C, E, and F**. Also indicate which of these is the best route used by the node for forwarding. You may provide the answers assuming the routing and forwarding information has converged to a steady state after any changes. [2.5+ 2.5 +2.5+ 2.5]

a. When the topology is static as shown in the figure above.
b. When the links A-F and E-F go down.
c. When nodes E and G go down.
d. When node F goes down.

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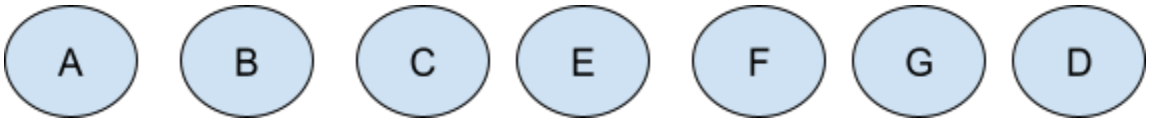
Q7. Consider this multihop network of 7 nodes. Each node is within radio range of its adjacent node. Every node has a half-duplex radio, that can only send or receive (but not both) at a time.



A has an interference range of 2
B has an interference range of 2
C has an interference range of 3
E has an interference range of 2
F has an interference range of 5
G has an interference range of 2
D has an interference range of 1

a. Now, calculate the maximum transport datarate (/throughput) of all the nodes A-G when the maximum possible transport datarate is R (your answer should be in terms of R) [2]

b. Now, calculate the maximum transport datarate (/throughput) of node A-G according to PIP protocol. Assume there are 3 non overlapping channels (i.e., transmissions over these 3 channels won't interfere with each other). Show the slot and channel assignment of all the nodes. Compute the max possible transport datarate (or throughput) of the network (your answer should be in terms of R) [2]

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Q8. Suppose, there are 2 clients C1 and C2 connected to an AP. Suppose, C1 is WiFi 5 compatible and C2 is WiFi 6 capable. The AP supports both and both clients have full buffer traffic to be sent to the AP. Suppose CWmin and CW max values for WiFi 5 are 32 and 1024 respectively and for WiFi 6 they are 16 and 512. The slot time for WiFi5 is 10us and for WiFi6 is 9us. The SIFS value=10us for both. Which client will provide better performance and explain the reason? [2]