

CMPE 206-01 Computer Network Design Spring 2020

HW#3 Solutions

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Solution 1)

1.1.

Githublink: <https://github.com/spring2020-cmpe206-01/HaoRan-012494781>

1.1

a). Since A can interact with all stations, and other station will see A's packets, so when A is sending to B, all nodes will notice and no other communication is possible.

b). Since B is sending to A, and A can interfere with other nodes, so no communication is possible.

c). B's packet could be seen by ACE, so E can send to D at the same time.

1.2

Since it needs to be detected while transmitting the data, and for wireless, it's impossible to know the collision, instead the wired medium could detect the collision, so CSMA/CD is for wired network not wireless network.

1.3

No, Because if we only use physical layer, it will not detect the hidden station, since it will only detect the channel signal power, and if the power of signal < threshold, it thought the channel will be free and send data and therefore cause collision.

1.4

Virtual Carrier Sensing is based on physical Carrier Sensing, besides physical carrier sensing has his own responsibility that is detecting if the channel is busy and etc.

1.5

For the worst case, s has the highest slot number, and all the node has data to send, then it will wait until the others finish sending data.

1.6

Stations: 2, 3, 5, 7, 11, 13 want to send.

Slot1: 2, 3, 5, 7, 11, 13

Slot2: 2, 3, 5, 7

Slot3: 2, 3

Slot4: 2

Slot5: 3

Slot6: 5, 7

Slot7: 5

Slot8: 7

Slot9: 11, 13

Slot10: 11

Slot11: 13

So totally, we need 11 slots

2.

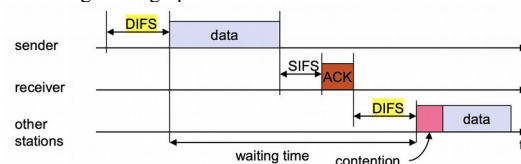
For the first time, it will cause collision, the second time each station pick randomly from either 0 or 1, so the collision possibility is $\frac{1}{2}$, therefore for the k round the possibility would be $1/2^{k-1}$ (it choose integer from 1 to 2^{k-1}). so for the k-1 times fail and the round k is success, the possibility would be :

$$P_k = \left(\prod_{i=1}^{k-1} \frac{1}{2^{i-1}} \right) \times \left(1 - \frac{1}{2^{k-1}} \right) \dots \dots (1)$$

According to the equation, we could get the Mean number of round k's contention period is $\sum_{i=k} (kp_k)$

3.1

According to the graph below:



We can see the Total time to transmit a data frame is composite with DIFS, DATA, SIFS, ACK, and from the piazza, I know there will be contentions, even though there is no RTS and CTS.

Therefore: transmit DATA with the Header

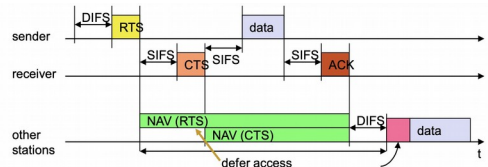
$$T_{\text{data}} = (28 + 1248) * 8 / (54 * 10^6) * 10^6 = 189.04 \mu\text{s}$$

$$T_{\text{ack}} = (14 * 8) / (54 * 10^6) * 10^6 = 2.07 \mu\text{s}$$

$$T_{\text{total}} = T_{\text{contention}} + \text{DIFS} + T_{\text{data}} + \text{SIFS} + T_{\text{ack}} = 36 + 34 + 189.04 + 16 + 2.07 = 277.11 \mu\text{s}$$

$$\text{Then the Mac Layer throughput} = 1248 * 8 / 277.11 = 36.03 \text{ Mbps}$$

3.2



When we use RTS and CTS, we have more SIFS to go, because RTS and CTS are also frames.

$$T_{\text{rts}} = 20 * 8 / 54 = 2.96 \mu\text{s}$$

$$T_{\text{cts}} = 14 * 8 / 54 = 2.07 \mu\text{s}$$

$$T_{\text{total}} = T_{\text{contention}} + \text{DIFS} + T_{\text{rts}} + \text{SIFS} + T_{\text{cts}} + \text{SIFS} + T_{\text{data}} + \text{SIFS} + T_{\text{ack}} = 314.14 \mu\text{s}$$

$$\text{Throughput} = 1248 * 8 / 314.14 = 31.78 \text{ Mbps}$$

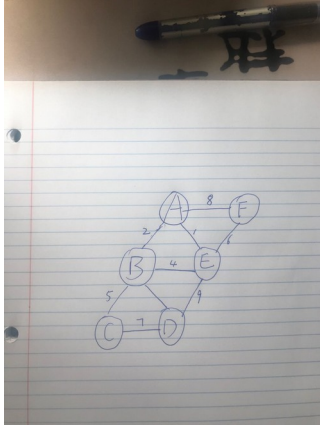
4.1

Dest	Next	Metric
A	A	0
B	B	2
C	D	4
D	D	1

4.2

Dest	Next	Metric
A	A	0
B	B	2
C	B	3
D	D	1
E	C	5

5.1



5.2

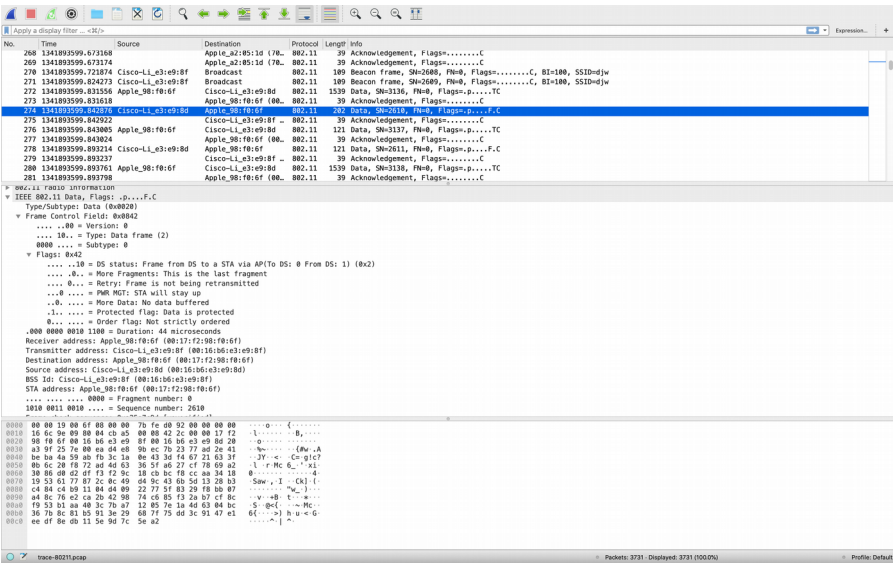
B->A->E

5.3

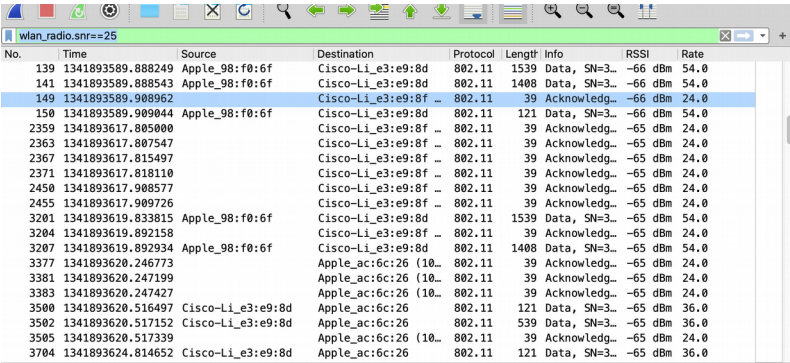
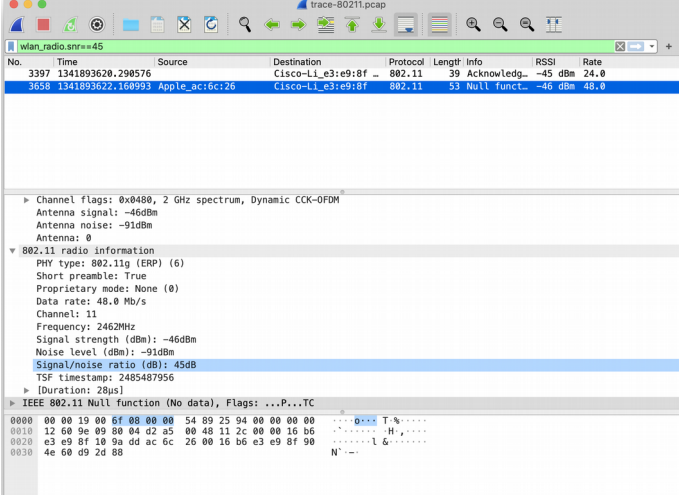
A->E->F

6.1

My last ID is 1, so I will look for n=274



6.2
a. There are 2 packets with SNR=45dB. There are 25 Packets with SNR=25dB



Statistics

Measurement	Captured	Displayed
Packets	3731	25 (0.7%)

b.

for the packets that are retransmitted, I use expression

Filter: wlan.fc.retry==0

No.	Time	Source	Destination	Protocol	Length	Info
23	1341893579.887081	Apple_98:f0:6f	Cisco-Li_e3:e9:8d	802.11	1539	Data
373	1341893605.483339	Cisco-Li_e3:e9:8f	Apple_ac:6c:26	802.11	103	Pr
387	1341893605.503619	Cisco-Li_e3:e9:8f	Apple_ac:6c:26	802.11	103	Pr
388	1341893605.505621	Cisco-Li_e3:e9:8f	Apple_ac:6c:26	802.11	103	Pr
396	1341893605.527166	Cisco-Li_e3:e9:8f	Apple_ac:6c:26	802.11	103	Pr
452	1341893605.594307	Cisco-Li_e3:e9:8f	Apple_ac:6c:26	802.11	103	Pr
453	1341893605.595877	Cisco-Li_e3:e9:8f	Apple_ac:6c:26	802.11	103	Pr
454	1341893605.597094	Cisco-Li_e3:e9:8f	Apple_ac:6c:26	802.11	103	Pr
455	1341893605.600343	Cisco-Li_e3:e9:8f	Apple_ac:6c:26	802.11	103	Pr
456	1341893605.603829	Cisco-Li_e3:e9:8f	Apple_ac:6c:26	802.11	103	Pr
457	1341893605.612070	Cisco-Li_e3:e9:8f	Apple_ac:6c:26	802.11	103	Pr

Frame 23: 1539 bytes on wire (12312 bits), 1539 bytes captured (12312 bits) on interface
 Radiotap Header v0, Length 25
 802.11 radio information
 IEEE 802.11 Data, Flags: .p..R..TC
 Type/Subtype: Data (0x0020)
 Frame Control Field: 0x0049
00 = Version: 0
 10.. = Type: Data frame (2)
 0000 = Subtype: 0
 Flags: 0x49
01 = DS status: Frame from STA to DS via an AP (To DS: 1 From DS: 0)
0.. = More Fragments: This is the last fragment
 1... = Retry: Frame is being retransmitted
 0... = PWR MGT: STA will stay up
 ..0. = More Data: No data buffered
 .1.. = Protected flag: Data is protected
 0... = Order flag: Not strictly ordered
 .000 0000 0010 1100 = Duration: 44 microseconds
 Destination address: Cisco-Li_e3:e9:8d (00:15:5d:03:e9:8d)

Measurement	Captured	Displayed
Packets	3731	363 (9.7%)

For the packets Original transmissions I use “wlan.fc.type==2 && wlan.fc.retry==0” and I got data:

Filter: wlan.fc.type==2 && wlan.fc.retry==0

No.	Time	Source	Destination	Protocol	Length	Info
16	1341893579.830184	Apple_98:f0:6f	Cisco-Li_e3:e9:8d	802.11	1539	Data
19	1341893579.886028	Cisco-Li_e3:e9:8d	Apple_98:f0:6f	802.11	121	Data
21	1341893579.886574	Apple_98:f0:6f	Cisco-Li_e3:e9:8d	802.11	1539	Data
25	1341893579.887345	Apple_98:f0:6f	Cisco-Li_e3:e9:8d	802.11	1408	Data
27	1341893579.904589	Cisco-Li_e3:e9:8d	Apple_98:f0:6f	802.11	121	Data
29	1341893579.904667	Cisco-Li_e3:e9:8d	Apple_98:f0:6f	802.11	121	Data
31	1341893579.905333	Cisco-Li_e3:e9:8d	Apple_98:f0:6f	802.11	162	Data
33	1341893579.905427	Apple_98:f0:6f	Cisco-Li_e3:e9:8d	802.11	121	Data
108	1341893587.405117	Apple_98:f0:6f	Broadcast	802.11	281	Data
111	1341893587.436201	Apple_98:f0:6f	Broadcast	802.11	281	Data
125	1341893588.820730	Apple_98:f0:6f	Cisco-Li_e3:e9:8d	802.11	1539	Data

Frame 27: 121 bytes on wire (968 bits), 121 bytes captured (968 bits) on interface
 Radiotap Header v0, Length 25
 802.11 radio information
 IEEE 802.11 Data, Flags: .p....F.C
 Type/Subtype: Data (0x0020)
 Frame Control Field: 0x0042
00 = Version: 0
 10.. = Type: Data frame (2)
 0000 = Subtype: 0
 Flags: 0x42
10 = DS status: Frame from DS to a STA via AP (To DS: 0 From DS: 1)
0.. = More Fragments: This is the last fragment
 0... = Retry: Frame is not being retransmitted
 0... = PWR MGT: STA will stay up

Measurement	Captured	Displayed
Packets	3731	1430 (38.3%)

Therefore the transmit rate is $363/1430=25.38\%$

c.

there is no ACK frames that have a retry flag of 1.

Reference:

1. <https://www.chegg.com/homework-help/questions-and-answers/answer-following-questions-csma-3-5-sentences-21-carrier-sense-multiple-access-cs-threshold-q24171301>
2. <https://www.wireshark.org/#learnWS>
3. https://en.wikipedia.org/wiki/IEEE_802.11_RTS/CTS