COMP4336/9336 Mobile data networking
W3 Quiz: WiFi Basics + Mainstream WiFi

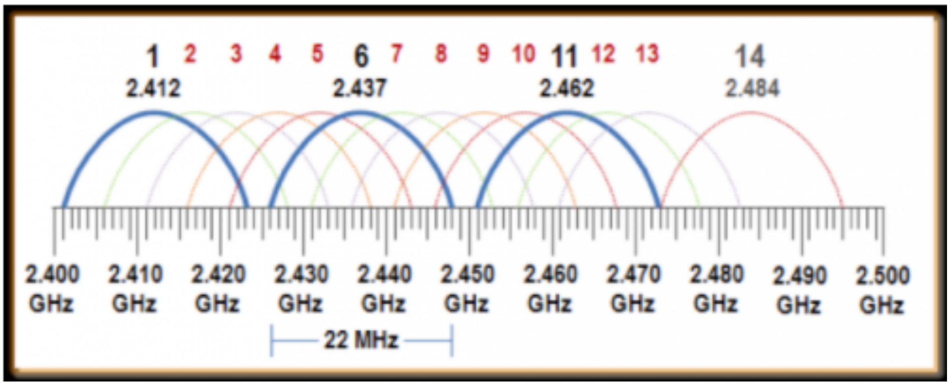
Q1. Which of the following mechanism helps address the hidden node problem in WLAN?

a) Carrier Sensing
b) RTS/CTS
c) MIMO
d) Virtual Carrier Sensing
e) DCF

Q2. Although a total of fourteen 22-MHz channels is defined for 2.4 GHz DSSS WLANs, the 14th channel is not always available. The first 13 channels follow the 5 MHz channel spacing for the centre frequency (starting from 2412) with 11 MHz assigned on both sides of the centre frequency. If we consider the first 13 channels, a maximum of three non-overlapping channels exist, where (1, 6, 11) is an example of a set of three non-overlapping channels. Can you identify another set of three non-overlapping channels among the first 13 channels?

a) (1,8,13)
b) (1,5,12)
c) (1,11,13)
d) (3,8,11)
e) (5,10,13)

A2. There are several sets of 3 non-overlapping channels. (2,7,12), (1,8,13), etc. Lecture Slide #11 and #12:



Q3. How many successive unsuccessful transmission attempts are required for the Congestion Window (CW) variable to reach its maximum value in an 802.11b WLAN?

a) 3
b) 4

- **c) 5**
- d) 6
- e) 7

A3

For 802.11b, CWmi[illegible]023. After n^{th} unsuccessful attempt, CW = (2^n x CWmin + 2^n -1, CW[illegible]CWmin + 2^n -1 = 1023. Therefore, after 5 successive unsuccessful transm[illegible] will reach its maximum value.

Q4. A WiFi frame has the following contents in its first three address fields, ADR1 to ADR3, respectively: Mobile device MAC Address, Access Point MAC address, and Server MAC Address. Which of the following is a likely transmitter of the frame?

- a) The mobile device
- b) The server
- **c) The Access Point**
- d) Either the mobile device or the server
- e) None of these

A4. Lecture Slides #35 (WiFi address fields table) and #37 (server to client transmission scenario)

Q5. What would be the maximum achievable data rate for a **single stream** 80MHz 802.11ac channel if it were allowed to convert 4 of its existing **data subcarriers** to **pilot subcarriers** to cope with the channel estimation challenges in a highly dynamic environment?

- a) ~452 Mbps
- **b) ~426 Mbps**
- c) ~470 Mbps
- d) ~383 Mbps
- e) ~852 Mbps

A5.

Lecture slide #30 (# of data carriers and pilot carriers for different 802.11ac channels) and slide #31 (single stream data rates for different 802.11ac channels).

Existing # of data subcarriers for 80 mHz 802.11ac channel = 234
With 4 converted to pilot, # of data subcarriers = 230

The maximum data rate would be 230/234 times the existing maximum data rate of 433.33 Mbps : (430/434) x 433.33 = 425.9 Mbps. (~426 Mbps)

Q6. Which WiFi has the lowest symbol rate?

a) 802.11a
b) 802.11b
c) 802.11n
d) 802.11ac
e) 802.11ax

A6. Slide #38. 802.1 data pulse length of 12.8 microsec, which makes its symbol duration the e symbol rate, which is inverse of symbol duration, the lowest.

Q7.

The original OFDM for 802.11a-1999 has a 3200ns data pulse, but the effective symbol interval is extended by another 800 ns guard interval (GI) to cater for multi-path delay spread. If a low-spread environment reduces the GI by half, what will be the increase in symbol rate?

a) ~5%
b) ~11%
c) ~50%
d) ~100%
e) ~16%

A7.

Symbol rate with 800 ns GI = 1/(3200+800) = 0.25 Msps
Symbol rate with 400 ns GI = 1/(3200+400) = 0.2777 Msps

Increase in symbol rate = 0.2777 – 0.25 = 0.0277 Msps or approx.. 11% (0.0277/0.25 = 0.1108)

Q8. What could be the maximum achievable data rate for a single stream 802.11n if it were allowed to use a 1024-QAM and a coding rate of 7/8?

f) 650.33 Mbps
g) 262.5 Mbps
h) 750 Mbps
i) 1.8 Gbps
j) 1.2 Gbps

A8.

Minimum guard interval: 400ns (data interval=3200ns) -> 3.6μs symbol interval
Maximum modulation: 1024 QAM
Coding: 7/8
Maximum # of data carriers: 108 (for 40MHz bonded channels)
Coded bits per symbol = $\log_2 1024$ ✗ #-of-data-carriers = 10x108
Data bits per symbol = coding rate x coded-bits-per-symbol = 7/8 x 10x108 = 945

Symbol rate = 1/symbol-interval = 1/3.6Msps
Data rate (single MIMO stream) = symbol rate x data bits per symbol = (1/3.6) x 945 Mbps = 262.5 Mbps

Q9. 802.11ax achiev[illegible] compared to its predecessor, 802.11ac, by further shortening the guard [illegible]

a) TRUE
b) FALSE

A9. Slide #38: 802.11ax has actually increased its guard interval compared to 802.11ac. Hogher data rates result from the increased modulation rate (1024 QAM) and higher channel bandwidth (160MHz maximum) with ensuing higher number of data subcarriers (1960 for 160MHz).

Q10. Which of the following will help WiFi 7 increase its data rates compared to WiFi 6?

a) Use of more efficient coding rates
b) Use of more efficient modulation schemes
c) Use of GHz channels
d) Use of ultra-short guard intervals
e) None of these

A10. Slide #44: 4096 QAM is more efficient modulation than 1024 QAM used in WiFi 6.

End of W3 (Basic+mainstream) Quiz
