COMP4336/9336 Mobile data networking
W4 Quiz: 802.11af/ah/ad/ay

Q1.

A mobile device is equipped with an 802.11af WiFi chip that follows the US standard of 6MHz channels. The device is also equipped with two antennas to support its WiFi communications. What is the maximum data rate that this device can enjoy for its WiFi without using any channel bonding?

a) 30 Mbps
b) 26.67 Mbps
c) 106.68 Mbps
d) 53.34 Mbps
e) 53.34 Gbps

A1.
Maximum data rate with single stream (no MIMO) over 6MHz un-bonded channel: 26.67 Mbps

With 2 antennas, it can enjoy a maximum of 2 MIMO streams, which increases its maximum data rate to 2x26.67 = 53.34 Mbps

Q2. IEEE 802.11af WiFi signals can travel much longer distance than 802.11n WiFi signals because

A. 802.11af uses lower frequency
B. 802.11af uses higher transmission power
C. 802.11af uses MIMO
D. 802.11af uses TV towers for transmissions
E. 802.11af uses higher channel bandwidth

A2.

Lower frequency can travel longer distance with the same transmission power (consult the Free-space path loss formula).

Q3.
In Example 4 (Slide 69, Week-4 (Niche-WiFi) lecture notes), the outcome of the SLS is the beam pair (3,1). For what range of RSS values recorded at the responder for the frame transmitted by the first antenna sector in A would lead to (1,1) as the SLS outcome?

A. RSS stronger than -50dBm
B. RSS weaker than -50dBm

C. RSS stronger than -64dBm
D. RSS weaker than -64dBm
E. RSS stronger than -62dBm

A3.
For the SLS outcome to be (1,1), A.1 has to produce the strongest signal at B. For RSS > -50 dBm, A.1's signal would be the strongest among all other sectors (note that A.3 is currently the strongest with an RSS of -50 dBm).

Q4. 802.11ay can achieve higher speed compared to 802.11ad because

A. It uses higher transmission power
B. It supports MIMO
C. It uses higher frequency
D. It uses higher channel bandwidth
E. None of these

A4. 802.11ad only supports single stream, but 802.11ay proposed up to 4 MIMO streams to boost the maximum data rates.

Q5. A smart TV is equipped with a 802.11ad WiFi chipset featuring 32 antenna sectors. Now assume that your mobilephone also boasts an 802.11ad WiFi but with only a 16-sector antenna. Now you want to cast your mobilephone screen to the TV screen using WiFi, hence the TV and the mobilephone have to search their best sector pairs for a reliable directional communication. In this scenario, searching the best sector pair using omnidirectional approach can reduce the total number of training frame transmissions, compared to the exhaustive search, by

a) 512 transmissions
b) 48 transmissions
c) 1024 transmissions
d) 64 transmissions
e) 464 transmissions

A5. Exhaustive search would transmit 32x16 = 512 training frames. Using omnidirectional approach would transmit only 32+16=48 frames. Savings: 512 - 48 = 464

Q6.
PHY-A uses a guard interval (GI) of 400 ns to combat inter-symbol interference. PHY-B is derived by down clocking PHY-A by a factor of 2. If PHY-B uses a data pulse of 3200 ns, what would be the symbol rate achieved by PHY-B?

a) 25 million symbols per second
b) 250 thousand symbols per second
c) 294 thousand symbols per second
d) 2.5 million symbols per second
e) None of these

A6.

GI of PHY-B = 2 x 400 ns = 800 ns.
Symbol length of PHY-B = 3200 ns + 800 ns = 4 μs.
Symbol rate = 1/4μs. = 0.25 million symbols per second = 250 thousand symbols per second

Q7.
What is the maximum number of non-overlapping channels possible in an 802.11ah network deployed in the U.S.A?

a) 13
b) 15
c) 20
d) 27
e) None of these

A7.
1 MHz is the narrowest channel bandwidth allowed in 802.11ah. In USA, 902-928 MHz has been allocated for 802.11ah, which provides a total bandwidth of 26 MHz. Therefore, a maximum of 26 channels (1 MHz channels) are possible in 802.11ah in USA.

Q8. In IEEE 802.11ad, BRP precedes SLS.

a) TRUE
b) FALSE

Q9. By executing the beam refinement protocol (BRP), a pair of devices can

a) Widen the beam that was selected by the sector level sweep (SLS)
b) Sharpen (narrowing) the beam that was selected by the sector level sweep (SLS)
c) Reduce the complexity of beam alignment
d) Communicate with two devices at the same time
e) Skip the Sector level Sweep (SLS) phase

A9.

BRP is optionally executed after SLS to further narrowing the beams for higher SNR.

Q10. During Beacon Time (BT) in 802.11ad,

a) AP has its antennas configured as omni-directional (or quasi-omnidirectional)
b) Non-AP devices have their antennas configured as omni-directional (or quasi-omnidirectional)
c) Both the AP and the non-AP devices have their antennas configured as omni-directional (or quasi-omnidirectional)

d) Neither the AP nor the non-AP devices have their antennas configured as omni-directional (or quasi-omnidirectional)
e) None of these

A10.

During BT, the PCP transmits training frames on all its sectors while all STAs listen in omni-direction mode. Thus, during BT, the PCP acts as the initiator, while all stations serve as the responders.

End of Quiz-4