Q1. What is the rece[...]pprox.) observed by a user equipment (UE) at a height of 1m from th[...]stance of 400 m from a 15 m high base station? The transmitter and recei[...]e 10 dBi and 5 dBi, respectively. Base station transmission frequen[...]nsmission power is 30 dBm.

a) 30 dBm
b) -35 dBm
c) 30 W
d) 62 mW
e) 30 dBW

A1.

D_{break} = 4(14*4*2*10⁹/3*10⁸) = 360m; thus at 400m, the UE is at far field and hence we can use the 2-ray model.

Path loss (dB) = $20\log_{10}[(400x400)/(1x15)]$ = 80 dB

Therefore, P_R = 30 dBm + 10 + 5 – 80 = -35 dBm (approx.)

Q2. With a subcarrier spacing of 100 kHz, how many subcarriers will be used in an OFDM system with 20 MHz channel bandwidth?

a) 2
b) 20
c) 200
d) 2000
e) None of these

A2.

Number of Subcarriers = $(20\times10^6)/(100\times10^3)$ = 200

Q3. Let us consider an OFDM system that uses the same carrier spacing irrespective of the channel bandwidth used. It employs 1024 subcarriers for 20 MHz channel. How many subcarriers will be used, approximately, if the channel was 2 MHz wide?

a) 1000
b) 110
c) 128
d) 102
e) 256

A3.

Inter carrier spacing = 20MHz/1024 = 19.53 kHz
Now, for a 2 MHz [...] 53 = ~102 subcarriers.

Q4. You have bough[t ...] uter with two dipole antennas claiming effective antenna gain of 6 dB[...] single dipole with 0 dBi gain and it claims a receiver sensitivity of -60 dB[...] [...]mum distance from the router your laptop can receive data if the ro[...] [...]smit power of 20 dBm?

a) 10m
b) 20m
c) 115m
d) 250m
e) 200m

A4.

We can tolerate a maximum pathloss of 86 dB (20+6+60 = 86). 2.4 GHz will lose 86 dB at 200 m. Beyond 200 m from the router, the laptop will receive signal strength below its sensitivity level, -60 dBm, and hence will not be able to decode information.

Q5. You have bought a 2.4 GHz WiFi router with antenna gain of 2 dBi and default transmission power of 100 mW. Your laptop has a 0 dB antenna gain and claims a receiver sensitivity of -60 dBm. Can you connect your laptop to the router from a distance of 150 m?

a) YES
b) NO

A5.

There is 83.56 dB path loss at 150 m. Therefore, the laptop will receive a signal strength of 20+2-83.56 = -61.56 dBm, which is below its receiver sensitivity. Therefore, the laptop **cannot** connect to the router.

Q6. Which of the following statements is TRUE?

a) An omni-directional antenna radiates power in all directions equally.
b) An isotropic antenna radiates power in all directions equally
c) A directional antenna usually has a gain of 0 dBi
d) Antenna gain refers to the ratio of the power at a particular point to the power with omnidirectional antenna
e) A device cannot use the same antenna for both transmission and reception

A6.

The answer should be obvious.

Q7. A lamp post would cause scattering for a 300 GHz transmission.

 a) True
 b) False

A7.

A 300 GHz signal has ~~wavelength of only~~ 1mm. Lamp posts are usually much wider objects having diameters on ~~the order of centi~~meters, hence are unlikely to serve as effective scatters for such high-freque~~ncy signals.~~

Q8. Which of the following statements is TRUE?

 a) OFDMA uses TDMA to share subcarriers between different users
 b) OFDM could use TDMA to share subcarriers between different users
 c) OFDM is a multiple access technology
 d) OFDMA is a multiplexing technology
 e) None of these

A8.

With multipaths, reflections from different paths keep coming to the receiver for some time, effectively widening the symbol interval.

Q9. Which of the following is a valid symbol length (bit interval) if the time difference between the first copy (LoS) and the last copy (NLoS) of the signal at the receiver is 800ns (ns=nano second)?

 a) 400ns
 b) 700ns
 c) 500ns
 d) 799ns
 e) None of these

A9. If symbols are shorter than delay spread, then signals with significant power from previous symbol will interfere with signals from the next symbol.

Q10. Which of the following statements is FALSE?
 a) Up to 30 MIMO channels could be created between a 10-anetnna base station and a 3-antenna mobile device
 b) MIMO is only useful in the presence of multipath and scattering
 c) MIMO can work even with a single-antenna mobile device
 d) Beamforming can be achieved without having to move antennas physically
 e) a 6x3 MIMO refers to 6 Tx antennas and 3 Rx antennas

A10. Even for LoS-only scenarios, the separation of multiple antennas in MIMO leads to uncorrelated LoS paths, thus providing spatial diversity benefits.

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End of Quiz-2