

SSY145 Wireless Networks

Quiz A7 Answer Key

Date: May 1, 2020

The solutions are marked in **boldface**.

1. Which of the following statements is/are correct about MIMO for microwave?
 - (a) A MIMO channel can be decomposed into multiple SISO sub-channels over different time and frequency band.
Motivation: over the same time and frequency band.
 - (b) **Optimal antenna separation gives 90 degrees phase shift between the cross-channels relative to the direct channels.**
Motivation: Fig. 12 shows the principle of MIMO for microwave transmission where the spatially separated antennas gives a path length difference of ΔD , which corresponds to a phase difference of 90 deg between the direct path and the cross path. By phase shifting by 90 deg and summing the received signal, the two data streams are restored perfectly and without any loss.
 - (c) 2x2 MIMO and 100 percent of optimal antenna separation gives over 3x SISO capacity.
Motivation: Around 2 times of the capacity.
 - (d) There is a trade-off between MIMO spectral efficiency and optimal antenna separation percentage for sub-optimal antenna arrangements.
Motivation: The trade off is between availability and spectral efficiency.
2. Which of the following is/are the challenge(s) of building integrated moving networks?
 - (a) **The backhaul design for the moving base stations, relays and cells.**
Motivation: Yes. Since there is mobility of these entities, transmission of the needed data to specified sites, or locations, becomes a problem
 - (b) **Interference coordination within the network**
Motivation: Yes. The frequency/frequencies in use are now "mobile", this will reduce SINR in some locations
 - (c) **The Handover process between the sites to ensure quality of service (QoS)**
Motivation: Yes. Based on set SLA/QoS profiles, it becomes quite difficult to always guarantee this.
 - (d) Deployment of SDN and NFV to support network slicing for managing the network
Motivation: No. This is not a challenge in V2X communication.
3. Which of the following is/are true from the 'Spectrum Management' lecture?
 - (a) **2.4-2.5 GHz Wi-Fi is considered to be apart of "Unlicensed spectrum".**
Motivation: True, ISM-band part of Unlicensed spectrum, slide 35.

- (b) FR1 is considered to be in the range of 24.25 GHz - 52.6 GHz.
Motivation: False, FR1 is considered to be in the range from below up to 6 GHz.
- (c) **FR2 is considered to be in the range of 24.25 GHz - 52.6 GHz.**
Motivation: True, FR2 lies in the range of 24.25 GHz - 52.6 GHz
- (d) **Auctions is a common method to assign spectrum to mobile operators.**
Motivation: True, auction is the common method. Slide 30.

4. Which of the following is/are incorrect about spectrum refarming?

- (a) **The technology changed from one to another should be located in the adjacent frequency band.**
Motivation: Incorrect description. Switch from one technology to another should be in the same frequency band.
- (b) Refarming improves the spectrum utilization.
Motivation: Correct description. Refarming will sometimes be necessary in order to improve spectrum utilization.
- (c) The spectrum should be reshuffled in order to have contiguous spectrum.
Motivation: Correct description. Government has reshuffled the spectrum so that all operators have contiguous spectrum.
- (d) Refarming can help deploy new technologies.
Motivation: Correct description. Refarming will sometimes be necessary in order to allow new technologies to be deployed.