SSY145 Wireless Networks
Quiz A5 Answer Key
Date: April 23, 2020

The solutions are marked in **boldface**.

1. Which of the following information is transmitted in physical uplink control channel?
   - **(a) Hybrid ARQ acknowledgement**
   - **(b) Channel-state feedback for multi-antenna operation**
   - (c) Number of mobile devices in the cell
   - (d) Scheduling request for downlink data awaiting transmission

     Motivation: Hybrid ARQ acknowledgments, as well as other uplink control information, such as channel-state feedback for multi-antenna operation and scheduling request for uplink data awaiting transmission, are transmitted using the physical uplink control channel (PUCCH).

2. Why are relays useful?
   - (a) Because they help to increase the capacity inside the area of the base station.

     Motivation: Lecture 05, slide 10: The capacity of the base station is reduced, since the users move to the coverage area of the relays.
   - **(b) Because they extend the area covered by the base station.**

     Motivation: Lecture 05, slide 10: If the relay is put in a right place outside of the BS coverage, it receives the signal from the base station and extends it.
   - (c) To make the capacity more uniform by putting the relays outside the coverage area of the base station.

     Motivation: Lecture 05, slide 10: The capacity can be more uniform when the relays are put INSIDE the coverage area of the base station.
   - **(d) To make use of the multi-hop approach in a distributive way by donating time slots from the base station.**

     Motivation: Lecture 05, slide 10: If the relays are put inside the coverage area of the base station, it may identify groups/subcarriers and allocate them to different users.

3. Which of the following is/are true about Coordinated Multi-Point (CoMP) schemes?
   - (a) In coordinated joint processing, data to a single user is transmitted from single transmission point.

     Motivation: Data to a single user is simultaneously transmitted from multiple transmission points.

(b) In coordinated scheduling, only the exchange of control data is required between nodes.

Motivation: Scheduling decisions do not require user data like it does in the coordinated joint processing.

(c) CoMP intends to solve the problem that cell edge users obtain only fraction of the average throughput in conventional LTE system.

Motivation: Coordinated multi-cell transmission and reception has the potential to improve the outage capacity and to smoothen the capacity over the cell areas.

(d) Feedback links and backhaul links introduce latency to the transmission loop of central unit (CU).

Motivation: The total latency = feedback links + 2 * backhaul links.

4. Which of the following is/are true regarding standards and different technologies mentioned in lecture 5?

(a) The IMT-Advanced defines capabilities that go beyond 4G systems.

Motivation: It's the realization of the 4G and defines capabilities which go further than that of IMT-2000 "3G" systems.

(b) One important concept for the WINNER system was cooperation between different standards.

Motivation: Smooth handovers between different generations of networks are important for continuous service and reliability.

(c) Relaying is important since it enables extended coverage but also for its possibility to get more uniform capacity in cells.

Motivation: When the relays are outside of the BS coverage and put in a right place, they can receive and extend the signal from the BS. When the relays are inside of the BS coverage, they can smoothen the capacity inside of the BS coverage.

(d) It is best to streamline different standards once the technology is widespread since it is easiest to make them compatible and minimize complexity once they're developed.

Motivation: It is better to do it beforehand since it can be quite hard to combine different complex systems. By doing it beforehand the industry has a consensus and different actors can position themselves on the market.