

PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Midterm Examination: Semester II	Academic Year: 2010
Date: December 23, 2010	Time: 9.00-12.00
Subject: 210-463 Telecommunication Engineering	Room: S817

Instructions:

- Allow a student to use his/her own calculator and dictionary.
- Grading policy
 - There will be no credit for vague answers or unclear steps.
 - A grader should be able to understand what you were trying to do without your verbal explanation later.
 - Give all your assumptions for your answer if necessary.

Do all four problems

1. Consider a 2G cellular system such as NA-TDMA that has mobile assisted handoffs. A mobile terminal measures signals from four base stations as a function of time. The times and signal strengths (in dBm) from the samples are given in Table 1. Assume the mobile terminal is initially attached to base station ID 1 (BS1). The mobile and BSC make handoff decisions by considering the signals from the base stations after each sampling time. For example, if just RSS is used, just after $t = 12.5s$, the mobile terminal would be connected to BS3.

Show the BS ID that a mobile terminal connecting to at each time point for each algorithm a, b, c and d. If a condition is met for more than one base station, assume the best one (strongest RSS) is selected.

- a. Received signal strength (RSS)
- b. RSS + handoff threshold of -60 dBm (i.e., only handoff is current BS RSS drops below -60 dBm)
- c. RSS + hysteresis of 10 dB (i.e., only handoff is the RSS of another BS exceeds current BS RSS by 10 dB)
- d. RSS + hysteresis of 5 dB + threshold of -55 dBm (i.e., only handoff is current BS RSS drops below -55 dBm and RSS of another BS is 5 dB greater than current BS)

Table 1 RSS measured by a mobile at different time points

Time(s)	0	2.5	5	7.5	10	12.5	15	17.5	20
BS1	-47	-57	-52	-55	-60	-62	-60	-65	-64
BS2	-59	-56	-55	-54	-52	-51	-49	-60.5	-52
BS3	-70	-72	-75	-70	-58	-50	-60.5	-62	-75
BS4	-72	-71	-65	-60	-55	-53	-50	-49	-56

(16 points)

2. Consider the AMPS forward (downlink) control channel. It has an effective data transfer rate of 1209.5 bps. In a typical AMPS system a maximum of 30% of the forward control channel bandwidth is dedicated to paging, a PAGE command requires 28 bits and on average must be repeated twice before receiving a response from the mobile.
- What is the maximum number of mobile terminating calls per hour that the system can handle in a geographic service area based on paging capacity.
 - If a geographic service area is divided into 10 paging areas of roughly equal load and when a mobile terminating call request is received only one paging area is paged,
 - what would the system paging capacity be?
 - What are the drawbacks of this approach?

(15 points)

3. Why is there a guard time in uplink NA-TDMA transmissions but not in downlink transmissions? What considerations determine the length of the guard time? What are the disadvantages of making the guard time too short or too long?

Note: You don't have to know details of NA-TDMA to answer this question.

(10 points)

4. Find the spectrum efficiency (unit: conversations/cell/MHz) of each wireless system described below.
- Consider an AMPS cellular system with the C/I requirement of 18 dB in a suburban propagation environment with the path loss coefficient of 4. Typically, AMPS downlink and uplink frequency ranges are 869-894 and 824-849 MHz, respectively. Each AMPS voice channel occupies a bandwidth of 30 kHz.
 - Consider an IS-95 CDMA cellular system with the SIR requirement of 6 dB for the transmission rate of 9.6 kbps. IS-95 and AMPS have the same downlink and uplink frequency ranges. Each IS-95 voice channel requires a bandwidth of 1.23 MHz.

(14 points)