

EITN85: Wireless Communications Channels, Assignment 2

Department of Electrical and Information Technology

Lund University, Sweden

Handout Date: Lecture time, February 12, 2021

Due Date: 5 pm, Monday 26 February, 2021

For Questions: Harsh Tataria (harsh.tataria@eit.lth.se) or Guoda Tian (gouda.tian@eit.lth.se)

1. Preparations for the Assignment

This assignment concerns the design of a channel sounder. To ensure that you are fully prepared to take on the assignment, it is strongly recommended that you revise the material from the relevant lectures, as well as the corresponding chapters/sections in the course textbook, *Wireless Communications* by Prof. Andreas F. Molisch.

2. Task

Imagine that you have a Master's degree in your hand from EIT, LTH, Lund University. Believe it or not, but this gets you into the top 1% of Master's graduates from any institution around the world in Wireless Communications. Looking at this, the future of wireless technologies is in your hands and you will go on to become the future leaders in wireless technology. After your Master's thesis, Ericsson AB has hired you to perform research into the fifth-generation (5G) of wireless systems. Your line manager, Dr. I.B. Nofool, has a lot of faith in you, and knows that you will deliver exactly what he asks for (since you are a graduate of Lund University). Today is the first day on the job and you are presented with the following brief by your manager:

You need to design a *channel measurement system(s)* to accurately measure the channel impulse response in typical outdoor environments, since your customers want to understand how the channel behavior really looks like in New York City (urban environment) (customer: Verizon) and San Francisco (sub-urban environment) (customer: T-Mobile). Just to give you an idea of the environments and their relative differences consider Figures 1 and 2:



Figure 1: Downtown Manhattan, New York



Figure 2: Typical San Francisco Street

In particular, your system(s) needs to be able to measure up to one kilometer of distance from the transmitter (TX) to the receiver (RX), at a center carrier frequency of 3.7 GHz. Irrespective of the location, you need to ensure that the RX signal-to-noise ratio (SNR) of 10 dB. Your system(s) should operate from 100 MHz to 400 MHz bandwidth and should be able to measure Doppler shifts on the order of 50 km/h. On the TX side, an angular resolution/beamwidth of 30 degrees in the azimuth and 15 degrees in elevation is desired, while on the RX side, azimuth and elevation angular resolutions of 70 and 30 degrees are needed. Your system(s) should perform as optimally as possible according to the above specifications. The total cost (in SEK) of the system(s) needs to be as low as possible, while meeting the above specifications.

Note: The assignment is deliberately left very open ended; since it is meant to encourage you to think critically and scientifically, but also in a cost effective manner about the task at hand.

3. Report

Create a report (using the same format as for Assignment 1) which demonstrates IN DETAIL your solution(s), assumptions, engineering decisions, engineering trade-offs, scientific design methodology and cost considerations.

Your report should clearly discuss the initial thoughts you have while thinking about the task at hand. You should also include any technical calculations, simulations, or other evaluations which you may have done. You should discuss how your design decisions would change if any one of the parameters described above in the brief would change. You should discuss the biggest challenges you foresee while implementing the system.

In addition to the other sections, at the beginning of the report, you should include an Executive Summary for your manager which summarizes your system(s) and its advantages/disadvantages in approximately five lines. If needed, you are encouraged to discuss your solutions with Harsh Tataria and/or Guoda Tian.

Submit your assignment no later than 5 pm, Monday 26 February, 2021 to harsh.tataria@eit.lth.se. Name your file EITN85-ASSIGN2-Lastname1_Lastname2.pdf.

If you discuss ANY part of the assignment with anyone else in the class, you need to declare this on the front page of the assignment report document.

Good luck!
