COMP40660: Advances in Wireless Networking

School of Computer Science, University College Dublin, Ireland
Spring 2023

Assignment 5: Theoretical Capacity

This assignment is worth 10% of the overall grade.

In this assignment the objectives are to

- explore the Nyquist and Shannon capacity models.
- plot graphs to show how capacity changes with system parameters.
- calculate the type of modulation required for a number of noisy, bandlimited channels.

Exercise:

1. Plot the **capacity** of a **noise-free** system as a function of bandwidth for BPSK, QPSK, 16QAM, 64QAM, 256QAM, and 1024QAM modulation schemes. For each scheme, let the bandwidth vary from 20MHz to 160MHz in steps of 1MHz.
2. Plot the **capacity** versus **SNR** for a **noisy** channel. Let the SNR vary from 6dB to 36dB. Plot for four different bandwidths: 20MHz, 40MHz, 80MHz, and 160MHz.
3. Extend the models from part 1 & 2 to take the Shannon capacity into the Nyquist capacity formula and determine the **required modulation format** *(Please refer the lecture notes for example calculations)* Do this for the following channel conditions: bandwidth of 20MHz, 40MHz, 80MHz, ***and*** 160MHz; for each of these bandwidths, use SNR values of 5dB, 10dB, 20dB, 30dB ***and*** 45dB ***(Total of 20 channel conditions)***

Instructions:

Follow the Technical background.pdf attached with the tutorial.

Use Excel or similar spreadsheet application.

One file (in ***.pdf*** format) with plots, calculations, and (if appropriate) discussions
NOTE: you must provide details of ***how*** you calculated the values that you plot

Submit your .pdf file through COMP40660 page on Brightspace. You can submit as many times as you like – your last submission before the deadline is the one that will be graded.

This is an **individual** assignment: no group submissions will be accepted and there should be no collaboration on the assignment.

Anti-plagiarism tools and techniques will be used to check your submission.

Submission deadline: Monday 30th April 2023, 23:59 sharp!!

End of the assignment
