# Project Description, EITN21, part two, HT2, 2024

Fredrik Tufvesson

**Task 1:** Your task is to implement an OFDM system over the audio channel via speakers and mics. The system should be capable of transferring a file (text, picture etc.) from one computer to another. Most system parametes are optional, but the system must include the following components:

- A minimum of 64 subcarriers, 75-80% of them being used for data or pilots, the outer 20-25% being inactive (modulated with zero).
- 4-QAM symbol constellation, or larger.
- A preamble with pilots only, then data together with 4 sub-channels with continous pilot symbols.
- Your system must at least operate at 0.5 kb/s.
- Minimum separation between speaker and microphone is 1 meter.
- Minimum length of file: 20000 bits.

A convolutional code is optional, and can be used if there is need for it. As soon as you can, reliably, transmit and decode the signal, you have passed Task 1. If you have stereo speakers and microphones you could also consider to implement MIMO or Alamouti coding to enhace the data rate or improve reliability, especially if you are an ambitious student. Do not forget to look at (by plotting them) the signals that you are transmitting. If they have a large peak-to-average power ratio it might be good to consider the use of a scrambler.

**Task 2:** A full duplex system should be implemented. The system should be packet based, and each packet must consist of at most 1000 information bits. In addition, parity bits should be inserted at the transmitter for each packet via a CRC. All packets are next sent to the receiver, which decodes each packet, and verifies the parity bits. The system parameters are the same as for task 1. Note that the packet length is subject to optmization. If the packet length is long, there will be many re-transmissions. The receiver next acknowledges the correctly decoded packets, and asks for re-transmission of the incorrectly decoded packets. The transmitter now re-transmits the requested

packets. This process is repeated until all packets have been correctly received at the receiver. A particular nice way to present this task is to let the file represent a picture. Then the reciever can plot the correctly decoded packets to the screen, while the inccorect packets show up as noise.

**Form of presentation:** This audio based part should be submitted no later than, Dec 1, 2024. There will be ONE chance to correct and resubmit the report directly after the presentation if necessary, further resubmissions are examined during the re-exam periods.

The written report should be 3-5 pages, and include a block diagram of the system, a plot of the results and with the full code as an appendix. As an engineer you of course compare your results to theoretical results where applicable, and show that you have reached the goal or met the requirements. The report should look nice, and be written using proper English. Graphs should be crisp and have labels and axis descriptions. Include a scatter plot so that you can analyze the received constellation diagram. Plot the signals you are transmitting to make sure that they look as you want them to look. Analyze also (and hence plot) how the phase of the continuous pilots evolves over time and frequency. What is the raw bit error rate (before decoding), theoretical and practical bit rate your system can achieve during transmission? Include your code as plain text in an appendix at the end of the report, without row/line numbers and any frame. Of course it is not allowed to use ChatGBT or any other AI tools as the purpose is that you also should learn the whole coding process.

**Both members of the group will be examined individually! All details of the system must be known to both group members.**