Project Description, EITN21, part three, HT2, 2023

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Your task is to implement a basic OFDM based file transfer system over the radio channel using the ADALM Pluto software defined radio. There are two tasks in part thee:

- Task 1 - the basic link: Implement an OFDM tranceiver and send a file between the Tx and Rx part of the same Pluto SDR.
- Task 2 - the advanced link: Transfer the file from one Pluto to another Pluto over the radio channel.

Some system parametes are optional, but the following system parameters should be used:

- Channel bandwidth 20 MHz. Center frequency 2.41-2.49 GHz.
- FFT size of 512, whereof 300 active sub-channels.
- Length of the cyclic prefix 128.
- A preamble with repeated pilot, then data *together with* continous pilots at sub-channels 1, 101, 201, 301.
- No data at the carrier frequency, i.e. put a zero at sub-channel 151.
- Minimum file size to transmit is 20 kbit.
- A convolutional code is optional, and can be used if there is need for it.

Make sure that you are not transmitting radio signals in bands where your are not allowed to transmit. Some helpful hints:

- Start simple, verify that the SDR is working with known functions as a first step. Start with spectrum app provided by Analog Devices.
- Verify your code stepwise.
- Look at your signals (transmitted and received) by plotting them in Matlab. Make a scatter plot of received symbols.
- Use the loopback cable between Tx and Rx for task 1.
- Observe what happens to the continous pilot symbols, especially in Task 2. Each continous pilot should have a stable amplitude and constant phase over time.
- The antennas are not optimized for 2.4 GHz operation, but they work there.

- For task 2, verify your carrier frequency offset compensation with the loopback cable and intentional frequency offset of the Rx carrier frequency.
- Try some of the more advanced stuff found on the web.
- Use scrabling to avoid trouble with amplitude peaks or spectral peaks due to repeated data.

Form of presentation: The report for part thee should be submitted no later than Jan 5, 2024, at 12.00. If you fail to meet the deadline, the next time to present is in the re-exam period. 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 reports should be 3-5 pages written reports including a block diagram of the code, 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 how the phase of the continuous pilots evolves over time and frequency. What is the practical and theoretical data rate your system can achieve? What is the raw bit error rate (i.e. before decoding)? 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 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.