EE698H: 5G Wireless Standard Design   **EE Dept. IITK**

Tutorial-1

5G PDSCH transcevier chain-I   *Jan 2022*

1. *5G system design:* We will design a 50-MHz 5G NR system with $N = 4096$ point FFT with $\Delta f = 15$ kHz, and usable bandwidth is 49.5 MHz. Calculate the following:

   (a) Sampling rate.

   (b) Slot and sub-frame duration.

   (c) Number of slots in a sub-frame.

   (d) CP length for the first and eigth symbols such that the rest of the symbols in a slot have a CP length of 288 samples.

   (e) calculate the maximum number of users which can be served in a slot if each of them is allocated a PRB over one symbol

2. *HARQ*: We consider a 5G OFDM system with a simplified block flat-fading channel model, where the channel is considered constant for the complete code block. When the channel is h_1, the BS transmitted a code block which the UE is not able to decode. When the channel changes to h_2, the BS retransmits the same code block (chase combining).

   - Design the optimal UE receiver for combining these two code blocks.
   - What will be the SNR again after optimal combining? Assume noise variance of σ^2.
   - Do you think chase combining will work if both h_1 and h_2 are bad.

3. *Rate matching:* For the given resource configurations over a slot for a 100 MHz system with 30 kHz subcarrier spacing and

   (a) MCS Index= 14, NPRB=100, TB size = 33816.

   (b) MCS Index= 4, NPRB=6, TB size = 576.

   Calculate the

   (a) Number of segmented code blocks and code block sizes.

   (b) Effective payload length with code-block CRC.

   (c) Lifting size Z_c, Number of filler bits.

   (d) Circular Buffer Lengths for each of the code block.

   (e) Four RV Indices.