TD CSC_52067_EP

LTE Peak Data Rate and NR Latency

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1 Introduction

In this TD we give an estimation of LTE downlink peak data rate by counting the available resources in a radio frame and removing resources dedicated to control signalling. Then, we estimate the NR latency depending on the frame structure.

2 LTE Peak data rate

Question 1 *What is the largest signal bandwidth in LTE? What is the corresponding number of Resource Blocks (RB)?*

Question 2 *We assume a normal prefix. How many OFDM symbols are there per slot? Per radio frame? Deduce the number of Resource Elements (RE) per radio frame.*

Question 3 *What is the minimum number of REs used by PDCCH, PCFICH and PHICH?*

Question 4 *How many REs are used by SSS, PSS and PBCH?*

Question 5 *Give an estimation of the protocol overhead due to Reference Signals (RS) for a 4 antenna transmission.*

Question 6 *What is the denser modulation in LTE? What is the maximum number of MIMO parallel flows? What is the duration of a radio frame? Deduce the raw peak data rate?*

Question 7 *We assume a coding rate of 3/4. Deduce the peak data rate in DL.*

Question 8 *Discuss the validity of the preceding result.*

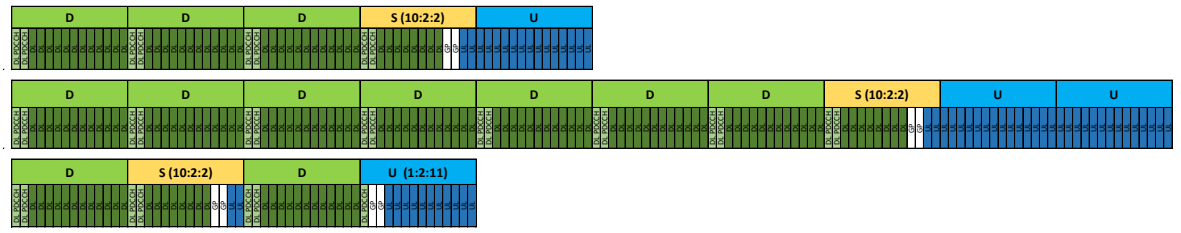

Figure 1: Three possible frame structures in 5G NR.

3 NR latency

In Figure 3, we show three 5G NR TDD frame structures with a sub-carrier spacing of 30 kHz (every small rectangle is a OFDM symbol). Here are some assumptions for the computation of the latency with each of these frame structures:

- We assume that the sub-carrier spacing is $\Delta f = 30$ kHz, the cyclic prefix duration is 2.3 μs.
- In the figure, every OFDM symbol is denoted either "DL PDCCH" for the transmission of PDCCHs, or "DL" for a downlink transmission, or "UL" for an uplink transmission, or "GP" for a guard interval.
- The periodic schemes DDDSU, DDDDDDDSUU, DSDU repeat themselves indefinitely. With this notation, "D" means that there are only DL symbols, "U" that symbols are either UL or GP, "S" (for "special") means that there are DL, UL and GP symbols.
- We assume that a transmitted block occupies a single OFDM symbol. It is received by the MAC sub-layer at the beginning of the OFDM symbol before being transmitted.
- There is no allocation for a ACK.
- The first transmission is always successful.
- We neglect all processing times.

Question 9 1. *What is the OFDM symbol duration with and without cyclic prefix?*
2. *For every frame structure, give the duration of the periodic scheme in ms.*
3. *For every frame structure, give the minimum and maximum DL latency in number of OFDM symbols and then in ms. The latency should take into account the resource allocation, the data transmission and the reception of the ACK.*