

3. In a 5G NR system, consider the information that is provided in Table 1 below:

Table 1

Subcarrier Spacing (kHz)	Allocated Bandwidth (MHz)	Resource Blocks
30	50	120

Given that the number of subcarriers occupied by 1 resource block is 12,

- (a) Calculate the number of occupied subcarriers of the system.

(5 Mark)

Answer : 1a) 1个资源块占用 12条子载波

一共，120个资源块

$$\text{子载波个数 } N_{\text{sub}} = 12 \times 120 = 1440$$

- (b) Calculate the theoretical occupied bandwidth of the system.

$$B = N_{\text{sub}} \times B_{\text{sub}} = 1440 \times 30 = 43.2 \text{ MHz}$$

- (c) Given that possible FFT sizes are 2^n , where n is an integer. What is the most appropriate FFT size for the configuration above?

(5 Mark)

$$2^n \geq 1440$$

$$n \geq 11$$

$$2^{11} = 2048$$

2048 是最适合的FFT size

- (d) Given the FFT size in (c), how many unoccupied/guard subcarriers are there?

$$2048 - 1440 = 608$$

一共有 608 条未用的子载波间隔

- (e) Assuming that the channel quality is uniform throughout the subcarriers and is able support up to 64 QAM in each subcarrier, calculate the maximum physical layer data rate given that the duration of each slot is 500μs. [Hint: 1 slot has 14 Orthogonal Frequency Division Multiplexing (OFDM) symbols; assume all resource elements carry data]

(5 Marks)

$$\begin{aligned} R &= \log_2 64 \cdot \left(1/500 \times 10^{-6}\right) \cdot 14 \times 1440 \\ &= 6 \times 2000 \times 14 \times 1440 \\ &= 241.92 \text{ Mbps} \end{aligned}$$