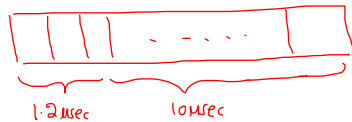


Problem 1:

Compute the spectral efficiency for an OFDM symbol described below. Spectral efficiency, η , is defined as the average number of information bits per second carried by the OFDM symbol, R_b , divided by the symbol bandwidth, B ; i.e. $\eta = R_b/B$. Here is the OFDM symbol description:

- 256 total subcarriers
- A useful part that is 10 μ s long
- A guard interval that is 1.2 μ s long
- Each subcarrier is modulated with 16-QAM



Total time = 11.2 μ sec

Time duration of one symbol: $\frac{11.2 \mu}{256} = 0.04375 \mu$ sec

Symbol Bandwidth, $B = \frac{1}{0.04375 \mu} = 22.857 \text{ MHz}$

One symbol carries 4 bits

256 " " \rightarrow 1024 bits

Guard interval = 1.2 μ sec

$\Rightarrow 0.04375 \mu$ sec $\xrightarrow{1.2 \mu}$ 4 bits

1.2 μ sec $\xrightarrow{1.2 \mu}$ $\frac{4 \times 1.2}{0.04375} = 110$ bits (Guard bits)

Useful Bits, = 1024 - 110 = 914

Hence Useful data rate = $\frac{914 \text{ bits}}{11.2 \mu\text{sec}} = 81.607 \text{ Mbits/sec}$

Now

$$\eta = 81.607 \frac{\text{Mbits}}{\text{sec}} \times \frac{1}{22.857 \text{ MHz}}$$

$$\boxed{\eta = 3.57 \text{ b/sec/Hz}}$$