

QUESTION-1

We need to design a system with user data rate of 1Mbps. Typical outdoor channels show RMS delay spread σ of $10\mu\text{s}$. Determine whether ISI will occur in a single carrier system? If yes, propose a multicarrier system that would avoid ISI. Please note that channel coherence bandwidth is defined as, $B_c = 1/5\sigma$ and frequency selectivity occurs when $\sigma < \text{symbol duration}/10$.

QUESTION-2

- How does OFDM work? Please briefly describe. What are the key advantages of OFDM over single carrier systems, such as WCDMA?
- Why do we need channel estimation in OFDM? Compare between the different methods used in OFDM.
- What is adaptive modulation in OFDM? Describe a method used for adaptive modulation used in OFDM.

QUESTION-3

A list of parameters of a Wireless LAN air-interface (IEEE 802.11a) using OFDM is given below:

- _ 64 subcarriers, 48 for data, 4 for pilots and 12 null subcarriers.
- _ Symbol duration $4\mu\text{s}$
- _ $0.8\mu\text{s}$ for CP
- _ BPSK, QPSK, 16-QAM, 64-QAM
- _ Convolutional coding with rate $1/2, 2/3 ; 3/4$
- _ System bandwidth 20MHz
- _ Bit rates of 6, 12, 18, 24, 36, 48 & 54Mbps

Calculate the following parameters:

- 1) FFT time-period
- 2) Sampling frequency
- 3) Sampling duration
- 4) Number of samples in the guard interval
- 5) Subcarrier frequency spacing
- 6) For different data rates, different coding scheme and different combination of modulation scheme, calculate
 - a) Coded bits per subcarriers
 - b) Coded bits per OFDM symbol
 - c) Data bits per OFDM symbol

QUESTION-4

We want to design an OFDM WiMAX system for a 60GHz channel with a max RMS delay spread of approximately 25ns (max delay spread around 200ns). The target bit rate is 80Mbps using rate $1/2$ coding and QPSK modulation.

Suggest the following parameters:

- 1) guard interval and FFT period
- 2) Number of FFT points (should be a power of 2)
- 3) Number of subcarriers used for data
- 4) Sampling frequency