ECE6604 Personal & Mobile Communications

Assignment #7

Date Assigned: April 2, 2009

Date Due: April 14, 2009

1) Text Problem 4.6

2) OFDM systems are known to be resilient to timing errors. Suppose that the OFDM waveform

$$\tilde{s}(t) = A \sum_{n=0}^{N-1} x_n e^{-j\frac{2\pi nt}{T}}$$

is sampled at time instants $t = kT_s + \Delta_t$, where Δ_t is a timing offset, to yield the received samples

$$R_k = \tilde{s}(kT_s + \Delta_t)$$

and an FFT is taken on the received samples.

a) Assume that the timing offset Δ_t is less than the guard interval such that all N FFT coefficients belong to the same OFDM block. Determine the FFT coefficients.

b) Now suppose that the timing offset Δ_t is greater the guard interval, such that the FFT coefficients do not all belong to the same OFDM block. Determine the FFT coefficients.

3) Consider a selective mapping scheme to reduce the PAPR of an OFDM waveform. The technique begins by generating L different random phase vectors of length N, i.e., generate

$$\boldsymbol{\phi}_l = (\phi_{l,0}, \phi_{l,1}, \ldots, \phi_{l,N-1}), l = 1, 2, \ldots, L$$

where the $\phi_{l,i}$ are uniformly distributed random variables on the interval $[-\pi, \pi)$.

Then for each $\boldsymbol{\phi}_n$ compute the PAPR of the OFDM waveform

$$\tilde{s}_l(t) = A \sum_{n=0}^{N-1} x_n e^{j\phi_{l,n}} e^{-j\frac{2\pi nt}{T}}, l = 1, 2, \ldots, L$$

and select the waveform having the smallest PAPR for transmission.

Consider $N = 256$ and 16-QAM symbols. Compute the mean PAPR and the variance of the PAPR of the transmitted OFDM waveform for $L = 1, 2, 4$.

4) Describe how you would combine Alamouti's transmit diversity scheme with OFDM. Show a block diagram of the transmitter and receiver. Be concise in your description.