OFDM

Exercise 1: Show that two subcarriers are orthogonal by finding the integral over a duration T_s of any two subcarriers with arbitrary amplitude and phase.

Exercise 2: The 802.11g WLAN standard uses OFDM with a sampling rate of 20 MHz, with $N = 64$. What is the subcarrier frequency spacing?

Exercise 3: How much more computation is required to compute a DFT ($O(N^2)$) versus an FFT ($O(N \log_2(N))$) for $N = 64$? For $N = 1024$?

Exercise 4: The 802.11g specification uses 52 of the $N = 64$ possible subcarriers and omits both the DC (zero frequency) and the highest-frequency subcarriers. What is the bandwidth of the signal?

Exercise 5: The 802.11g WLAN standard uses OFDM with a sampling rate of 20 MHz, with $N = 64$ and guard interval of $0.8\mu s$. What is the total duration of each OFDM block, including the guard interval? How long is the guard time?

Exercise 6: The 802.11g preamble contains a “short” followed by a “long” training symbol. The short symbol contains only every fourth subcarrier. What is the period of this symbol? The long training symbol contains fixed data on each of the data subcarriers. How would you use the long training symbol to correct the phase and amplitude of subsequently-received data subcarriers?

Exercise 7: A channel's impulse response is two equal-level impulses separated by 100 ns. What difference in propagation path lengths would result in such an impulse response? How far apart are the nulls of this channel? What OFDM signal bandwidth(s) would be required to provide frequency diversity?

Exercise 8: How many bits per subcarrier are transmitted by an OFDM system using 16-QAM? Assuming equal noise powers, how much more power does this system need to achieve the same BER than a system using 4-QAM? Than a system using BPSK?