

Exercise 8 in SSY135 Wireless Communications

Topic: Multiuser communications

Feb. 25, 2020

1. Consider an FDMA system for multimedia data users. The modulation format requires 10 MHz of spectrum, and guard bands of 1 MHz are required on each side of the allocated spectrum to minimize out-of-band interference. What total bandwidth is required to support 100 simultaneous users in this system?
2. GSM systems have 25 MHz of bandwidth allocated to their uplink and downlink, divided into 125 TDMA channels with 8 user time slots per channel. A GSM frame consists of 8 time slots and each time slot consists of 3 start bits at the beginning, followed by a burst of 58 data bits, then 26 equalizer training bits, another burst of 58 data bits, 3 stop bits, and a guard time corresponding to 8.25 data bits. The transmission rate is 270.833 kbps.
 - (a) Sketch the structure of a GSM frame and a time slot within the frame. Find the fraction of data bits within a time slot, and the information data rate for each user.
 - (b) Find the duration of a frame and the latency between time slots assigned to a given user in a frame, neglecting the duration of the preamble and trail bits.
 - (c) What is the maximum delay spread in the channel such that the guard band and stop bits prevent overlap between time slots.
3. Find the minimum reuse distance and user capacity for a TDMA cellular system with hexagonally shaped cells, path-loss exponent=2 for all signal propagation in the system, and BPSK modulation. Note that for hexagonally shaped cells, the number of cells per cluster is $i^2 + j^2 + ij$, where i and j are integer numbers. Assume an AWGN channel model with required $P_b = 10^{-6}$, a total system bandwidth of $B = 48$ MHz, and a required signal bandwidth of 100 kHz for each user.