E 9.1

A direct-sequence system has a PN code rate of 192×10^6 chips per second and a binary message bit rate at 7500 b/s.

a. If QPSK instead of biphase modulation, what is the processing gain?

b. Assuming that the received signal power is 4×10^{-14} watts and the one-sided noise spectral density level, N_o, is 1.6×10^{-20} W/Hz, find the signal-to-noise power ratio in the input of the receiver of the power.

E 9.2

A frequency-hopping spread spectrum system is to have the following parameters:

Message bit rate = 2400 bps (after error correction coding)
Hops per message bit = 16
Frequency multiplication = 8
Processing gain ≥ 45 dB
$f_I t_I = 1$

- Find the smallest number of frequencies required if this number is a power of 2.
- Find the bandwidth of the spread spectrum signal

E 9.3

A direct-sequence system has a PN code rate of 40×10^6 chips per second and a binary message at 75 b/s. The received signal power is 2×10^{-15} watts and the receiver noise spectral density at the same point is 4×10^{-20} W-s. For this system, in which the correlation time is exactly one message bit, find the ratio of the code noise at the receiver noise at the output of the correlator when the system is not correctly synchronized.

E 9.4

Given the following parameters of a spread spectrum communication systems:

$N_o = 2\times10^{-15}$ W/Hz
J=Interference power = 5×10^{-7}

$P_r = 1.2 \times 10^{-8}$ watts

Equivalent receiver noise bandwidth = 50 MHz

a. Find the input SNR, $(SNR)_i$.

b. If the message bit rate is 10 kbps, find the output SNR, $(SNR)_o$.

E 9.5

A total of 30 equal-power users are to share a common communication channel by CDMA. Each user transmits information at a rate of 10 kps via DS spread spectrum and a binary PSK. Determine the minimum chip rate to obtain a bit error probability of 10^{-5}. Additive noise at the receiver may be ignored in this computation.

Homework-9 Deadline 08 April 2002 at 10.00

Homework return box is located at Otakaari 5, 2nd floor, near the E-wing. You can also return the answers to the assistant just before the class.

A CDMA system consists of 15 equal-power users that transmit information at a rate of 10kbps, each using a DS spread spectrum signal operating at a chip rate of 1 MHz. The modulation is binary PSK.

c. Determine the E_b/J_o, where J_o is the spectral density of the combined interference.

d. How much should the processing gain be increased to allow for doubling the number of users without affecting the output SNR?