

3.4 If 20 MHz of total spectrum is allocated for a duplex wireless cellular system and each simplex channel has 25 kHz RF bandwidth, find:

- (a) the number of duplex channels.
- (b) the total number of channels per cell site, if  $N = 4$  cell reuse is used.

3.7 Suppose that a mobile station is moving along a straight line between base stations  $BS_1$  and  $BS_2$ , as shown in Figure P3.7. The distance between the base stations is  $D = 2000$  m. For simplicity, assume small scale fading is neglected and the received power (in dBm) at base station  $i$ , from the mobile station, is modeled as a function of distance on the reverse link

$$P_{r,i}(d_i) = P_0 - 10n \log_{10}(d_i/d_0) \quad (\text{dBm}) \quad i = 1,2$$

where  $d_i$  is the distance between the mobile and the base station  $i$ , in meters.  $P_0$  is the received power at distance  $d_0$  from the mobile antenna. Assume that  $P_0 = 0$  dBm and  $d_0 = 1$  m. Let  $n$  denote the path loss which is assumed to be equal to 2.9.

Assume the minimum usable signal level for acceptable voice quality at the base station receiver is  $P_{r,min} = -88$  dBm, and the threshold level used by the switch for handoff initiation is  $P_{r,HO}$ . Consider that the mobile is currently connected to  $BS_1$  and is moving toward a handoff (time required to complete a handoff, once that received signal level reaches the handoff threshold  $P_{r,HO}$  is  $\Delta t = 4.5$  seconds).

- (a) Determine the minimum required margin  $\Delta = P_{r,HO} - P_{r,min}$  to assure that calls are not lost due to weak signal condition during handoff. Assume that the base station antenna heights are negligible compared to the distance between the mobile and the base stations.
- (b) Describe the effects of the margin  $\Delta = P_{r,HO} - P_{r,min}$  on the performance of cellular systems.

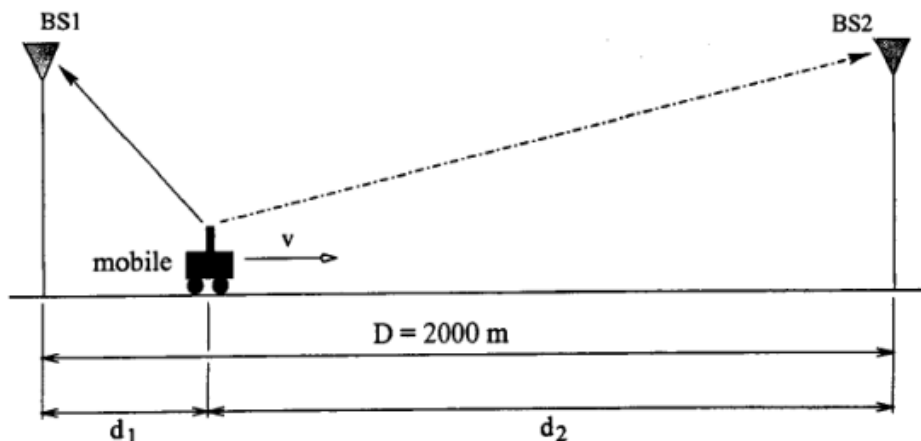


Figure P3.7 Cellular system with two base stations.

3.22 Determine the noise floor (in dBm) for mobile receivers which implement the following standards: (a) AMPS, (b) GSM, (c) USDC, (d) DECT, (e) IS-95, and (f) CT2. Assume all receivers have a noise figure of 10 dB.

3.23 If a base station provides a signal level of  $-90$  dBm at the cell fringe, find the SNR for each of the mobile receivers described in Problem 3.22.

- 3.27 The U.S. AMPS system is allocated 50 MHz of spectrum in the 800 MHz range and provides 832 channels. Forty-two of those channels are control channels. The forward channel frequency is exactly 45 MHz greater than the reverse channel frequency.
- (a) Is the AMPS system simplex, half-duplex, or duplex? What is the bandwidth for each channel and how is it distributed between the base station and the subscriber?
  - (b) Assume a base station transmits control information on channel 352, operating at 880.560 MHz. What is the transmission frequency of a subscriber unit transmitting on channel 352?
  - (c) The A-side and B-side cellular carriers evenly split the AMPS channels. Find the number of voice channels and number of control channels for each carrier.
  - (d) Let's suppose you are chief engineer of a cellular carrier using seven-cell reuse. Propose a channel assignment strategy for a uniform distribution of users throughout your cellular system. Specifically, assume that each cell has three control channels ( $120^\circ$  sectoring is employed) and specify the number of voice channels you would assign to each control channel in your system.
  - (e) For an ideal hexagonal cellular layout which has identical cell coverage, what is the distance between the centers of two nearest co-channel cells for seven-cell reuse? For four-cell reuse?