(c) Find the number of users that could use the system with 1% blocking if five trunked channels are available.

(d) If the number of users you found in (c) is suddenly doubled, what is the new blocking probability of the five channel trunked mobile radio system? Would this be acceptable performance? Justify why or why not.

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° 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?

3.28 Suppose that you work with a cellular service provider and the cellular radio system your company deployed in a given service area just reached its maximum system capacity. Your boss then asks you to carry out a study to analyze the application of cluster size reduction technique combined with sectoring, aiming to increase the carried traffic of the system.

The current deployed system employs the AMPS system, with 300 voice channels, cluster size $N = 7$, and omnidirectional antennas at the base stations. Base stations are located at the center of the cells and transmit the same power on the forward link. The designed blocking probability is 2% and all voice channels have been used. The maximum carried traffic per cell is, therefore, 32.8 Erlangs. The minimum *SIR* (worst case) on the forward link can be computed using the expression

$$SIR = 10\log_{10}\left[\frac{(\sqrt{3N})^n}{i_0}\right] \quad \text{(in dB)},$$

where n is the path loss exponent, N is the cluster size, and i_0 is the number of interfering base stations in the first tier. For cluster size $N = 7$, omnidirectional base station antennas ($i_0 = 6$), and $n = 4$, we find that $SIR = 18.7$ dB.

When the cluster size is reduced, the maximum carried traffic per cell increases, at the expense of SIR degradation. Sectorized base station antennas can then be used in order to increase *SIR* and guarantee that the link quality is maintained. In other words, the minimum *SIR* achieved when cluster size is reduced and sectorized antennas are used must be equal to or exceed the minimum *SIR* achieved in the current deployed system ($SIR = 18.7$ dB).

In your analysis of cluster size reduction and sectoring, consider forward link only. Two sectorized antennas types are available: $BW = 60°$ for six sectors per cell, and $BW = 120°$ for three sectors per cell, as shown in Figure P3.28a. Assume that all cells have hexagonal shape, with radius R.