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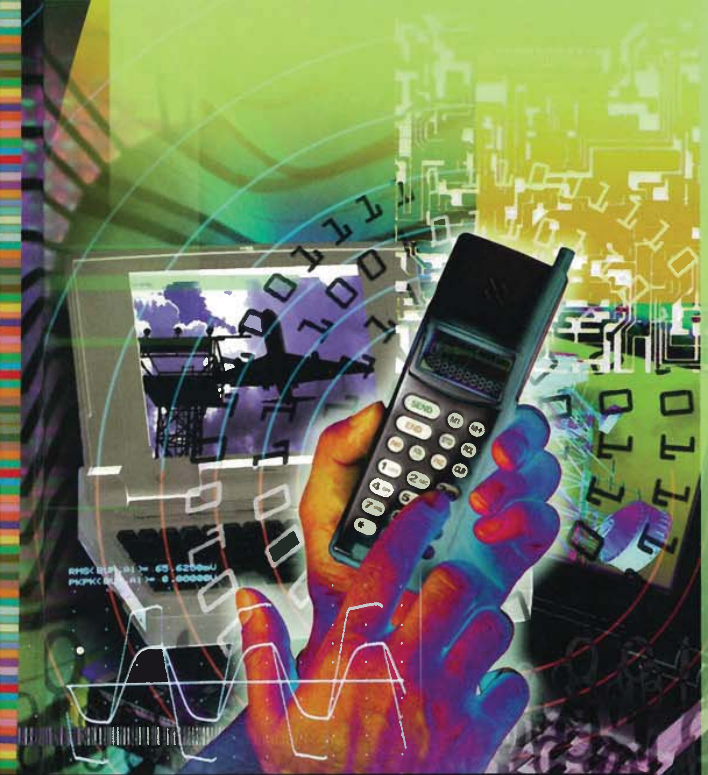
THEORY AND APPLICATIONS

SECOND EDITION



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Mobile Communications Engineering

Theory and Applications

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145	146	147	
166	167	168	
187	188	189	
208	209	210	
229	230	231	
250	251	252	
271	272	273	
292	293	294	
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331	332	333	Control channel sets
352	353	354	
373	374	375	
394	395	396	
415	416	417	
436	437	438	
457	458	459	
478	479	480	
499	500	501	
520	521	522	
541	542	543	
562	563	564	
583	584	585	
604	605	606	
625	626	627	
646	647	648	
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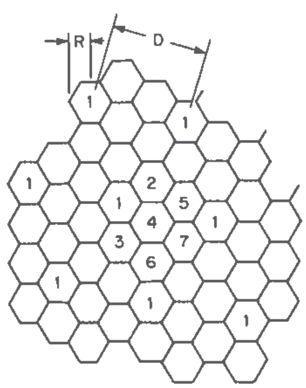
of channels, traffic variables, and the effectiveness of propagation-enhancement techniques. For purposes of explanation, we will temporarily disregard cell size. A typical area divided into cells is shown in Fig. I.2. Each block of seven cells is repeated in such a manner that corresponding numbered cells in adjacent seven-cell blocks are located at a predetermined distance from the nearest cell having the same number. Correspondingly, the 20-MHz-bandwidth radio spectrum is divided into seven disjoint sets, with a different set allocated to each one of the seven cells in the basic block. With a total of 333 channels in 21 sets available, it is possible to assign as many as three sets to each of the seven cells constituting the basic block pattern.

For blanket coverage of cell areas, each cell site is installed at the center of the cell (the dotted-line cell) and covers the whole cell, as shown in Fig. I.3. There is another way of looking at the locations of the cell sites. The three cell sites are installed, one at each alternate corner of the cell and cover the whole cell, as shown in Fig. I.3. In both cases, although the boundary of a cell is defined differently, the cell sites do not need to be moved. For convenience, the cells illustrated in Fig. I.3 are pictured as hexagonal in shape. In actual practice, the cell boundaries are defined by the minimum required signal strength at distances determined by the reception threshold limits. In the AMPS, base stations are referred to as cell sites because they perform supervision and control in addition to the transmitting and receiving functions normally associated with the conventional base station. Mobile-telephone subscribers within a given cell are assigned to a particular cell site serving that cell simply by the



$$K = \frac{(D/R)^2}{3}$$

Figure I.2 Basic cell block: R = radius of each cell; D = distance between two adjacent frequency-reuse cells; K = number of cells in a basic cell block. $K = 7$ in this illustration, and $D/R = 4.6$.

assignment of an idle channel frequency under the control of the mobile-telephone switching office (MTSO). When a mobile unit crosses a cell boundary, as determined by the signal reception threshold limits, a new idle channel frequency is assigned by the new serving cell site. This automatic switching control function is referred to as a "handoff."

The problems of cochannel interference are avoided by ensuring a minimum distance between base stations using the same channel frequencies, and by enhancing signal level and reducing signal fading through the use of diversity schemes. These constraints limit any potential cochannel interference to levels low enough to be compatible with the transmission quality of landline networks.

Two forms of diversity are used to enhance radio propagation, thus improving AMPS cell coverage. These are defined as "macroscopic" and "microscopic" diversity. Macroscopic diversity compensates for large-scale variations in the received signal resulting from obstacles and large deviations in terrain profile between the cell site and the mobile-telephone subscriber. Macroscopic diversity is obtained by installing directional antennas, one for each sector of three sectors at the cell center, or installing at the alternate corners of cells, as shown in Fig. I.3, and transferring control to the antenna providing the strongest average signal from the mobile subscriber in any given time interval. For example, the three cell-site transmitters serving a particular cell area would not radiate simultaneously on an assigned channel frequency. On the basis of a computer analysis of the signals received from the mobile subscriber at each of the three sites, the one with the strongest

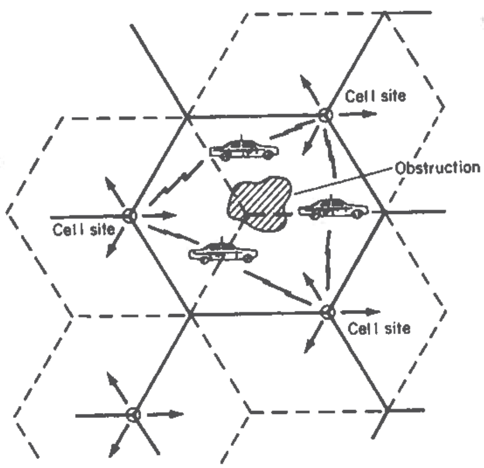


Figure I.3 Use of inward-directed antennas at alternate cell corners to achieve macroscopic diversity with respect to large obstructions.

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