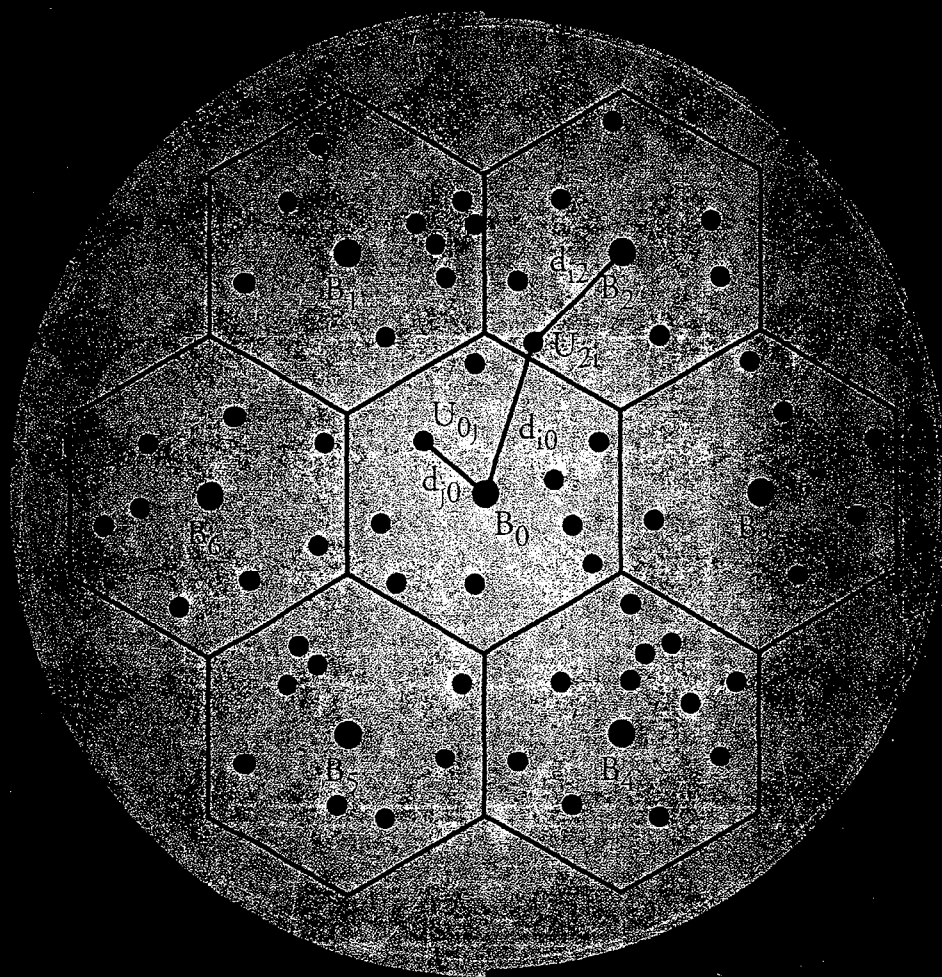


WIRELESS

communications

Principles & Practice



Theodore S. Rappaport

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Principles and Practice

Theodore S. Rappaport

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*The LORD has blessed me
with a wonderful family
to whom this book is dedicated*

*To my wife Brenda Marie,
and to our children
Matthew, Natalie, and Jennifer*

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The correlation coefficient is determined by three factors: polarization angle; offset angle from the main beam direction of the diversity antenna and the cross polarization discrimination. The correlation coefficient generally becomes higher as offset angle β becomes larger. Also, ρ generally becomes lower as polarization angle α increases. This is because the horizontal polarization component becomes larger as α increases.

Because antenna elements V_1 and V_2 are polarized at $\pm\alpha$ to the vertical, the received signal level is lower than that received by a vertically polarized antenna. The average value of signal loss L , relative to that received using vertical polarization is given by

$$L = a^2/\Gamma + b^2 \quad (6.78)$$

The results of practical experiments carried out using polarization diversity [Koz85] show that polarization diversity is a viable diversity reception technique.

6.10.5 Frequency Diversity

Frequency diversity transmits information on more than one carrier frequency. The rationale behind this technique is that frequencies separated by more than the coherence bandwidth of the channel will not experience the same fades [Lem91]. Theoretically, if the channels are uncorrelated, the probability of simultaneous fading will be the product of the individual fading probabilities (see equation (6.58)).

Frequency diversity is often employed in microwave line-of-sight links which carry several channels in a frequency division multiplex mode (FDM). Due to tropospheric propagation and resulting refraction, deep fading sometimes occurs. In practice, *1:N protection switching* is provided by a radio licensee, wherein one frequency is nominally idle but is available on a stand-by basis to provide frequency diversity switching for any one of the N other carriers (frequencies) being used on the same link, each carrying independent traffic. When diversity is needed, the appropriate traffic is simply switched to the backup frequency. This technique has the disadvantage that it not only requires spare bandwidth but also requires that there be as many receivers as there are channels used for the frequency diversity. However, for critical traffic, the expense may be justified.

6.10.6 Time Diversity

Time diversity repeatedly transmits information at time spacings that exceed the coherence time of the channel, so that multiple repetitions of the signal will be received with independent fading conditions, thereby providing for diversity. One modern implementation of time diversity involves the use of the