Chapter 4
INTERSYSTEM EMI PREDICTION
AND CONTROL

This chapter summarizes interference prediction and control between one or more potential culprit transmitters and one or more victim receivers immersed in a common electromagnetic ambient environment. The EMI prediction emphasizes the antenna-to-antenna mode of coupling. Reference 1 is suggested for the reader who desires a comprehensive treatment of intersystem EMI.

The basic EMI prediction equation is developed, with a summary of its comprehensive version involving many parameters. Separate mathematical models for transmitters, receivers, antennas, propagation, and signal acceptability criteria are summarized. Illustrative examples show how to make EMI predictions and how to effect EMI control in the presence of the signal of interest.

Most EMI intersystem predictions involve two or more potential culprit emitters, each having several spurious emissions in addition to the desired (fundamental) signal. Additionally, each receiver exhibits several spurious responses, in addition to the fundamental response, one or more of which may result in interference susceptibility. Thus, to facilitate selection and computation of EMI, the multi-transmitter/receiver prediction problem is based upon developing an effective culling process. This eliminates non-EMI (i.e., low probability) situations early in the prediction process to provide an efficient procedure.

BASIC PROPAGATION EQUATION

Figure 4-1 illustrates the geometry used to derive basic relationships between power delivered by a transmitter ($P_t$), transmitter antenna gain ($G_t$), power flow into a receiving antenna ($P_r$), receiver antenna gain ($G_r$), and the distance between the transmitter and receiver in meters ($R_m$). In Figure 4-1a, a transmitter Tx is located at the origin of a spherical coordinate system with a segment (octant) of a sphere of radius $R_m$ shown. If the transmitter delivers $P_t$ watts to an ideal isotropic radiating antenna, the power will be radiated homo-
geneously in all directions in the form of a spherical wavefront. The power density (power per unit area, $P_D$) will be uniform throughout the surface of the sphere and equal to: (2, 3)

$$P_D = \frac{P_t}{4\pi R_m^2} \text{ watts/m}^2 \quad (4-1)$$

In practice, radiating elements (antennas) do not radiate electromagnetic energy uniformly in all directions but tend to produce radiation patterns with some associated directivity; that is, a greater portion of the energy is transmitted along some propagation paths than others. This is referred to as antenna gain, $G$, or directivity, usually along a defined specific direction (axis)