

## APPENDIX 2A WHAT IS dB?

Decibel or dB is usually the unit employed to compute the logarithmic measure of power and power ratios. The reason for using dB is that all computation reduces to addition and subtraction rather than multiplication and division. Every link, node,

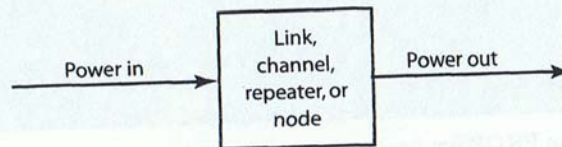


Figure 2A.1 Description of model for defining dB.

repeater, or channel can be treated as a *black box* (see Fig. 2A.1) with a particular decibel gain. The decibel gain of such a black box is given by

$$\text{db gain} = 10 \log \left( \frac{\text{power of output signal}}{\text{power of input signal}} \right) = 10 \log \left( \frac{P_{out}}{P_{in}} \right) \quad (2A.1)$$

This corresponds to the *relative* output power with respect to the input power. The logarithm is always to the base 10. If the ratio in Eq. (2A.1) is negative, it is a decibel loss.

The decibel gain relative to an absolute power of 1 mW is denoted by dBm and that relative to 1 W is denoted by dBW. For example, if the input power is 50 mW, relative to 1 mW, the input power is  $10 \log (50 \text{ mW} / 1 \text{ mW}) = 16.98 \text{ dBm}$ . If this is followed by a link having a loss of 10 dB, the absolute power at the output of the link will be  $16.98 - 10 = 6.98 \text{ dBm}$ . Relative to 1 W, these values will be  $10 \log (50 \times 10^{-3} / 1) = -13 \text{ dBW}$  and  $-23 \text{ dBW}$ , respectively.

Antenna gains are represented similarly with respect to an *isotropic* antenna (which radiates with a gain of unity in all directions) or a *dipole* antenna. The former gain is in units of dBi and the latter in units of dBd. The units in dBi are 2.15 dB larger than the units in dBd.