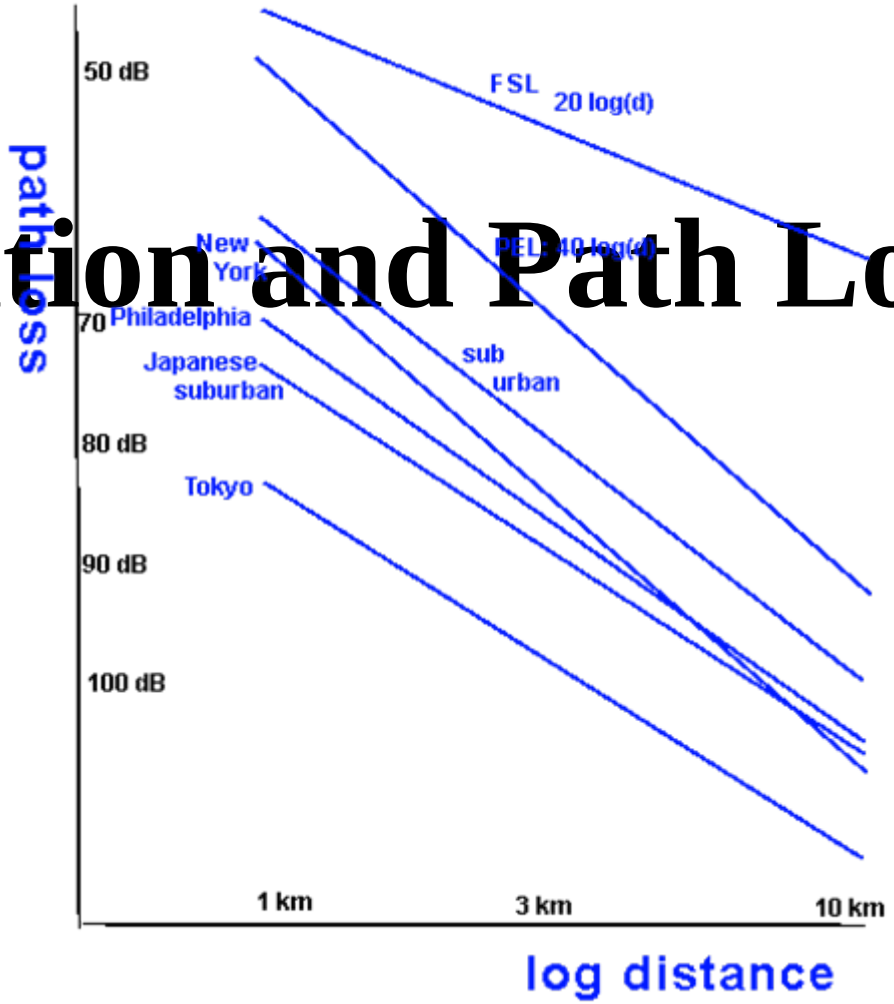
Attenuation and Path Loss



Path Loss

Free space path loss

- Size of surface $\propto r^2$
- Power density $\propto 1/ r^2$
- Path loss exponent: n = 2

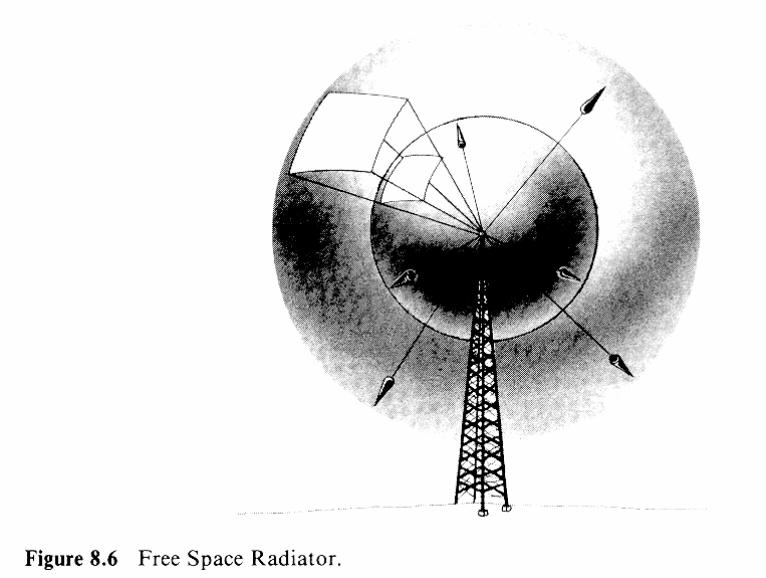


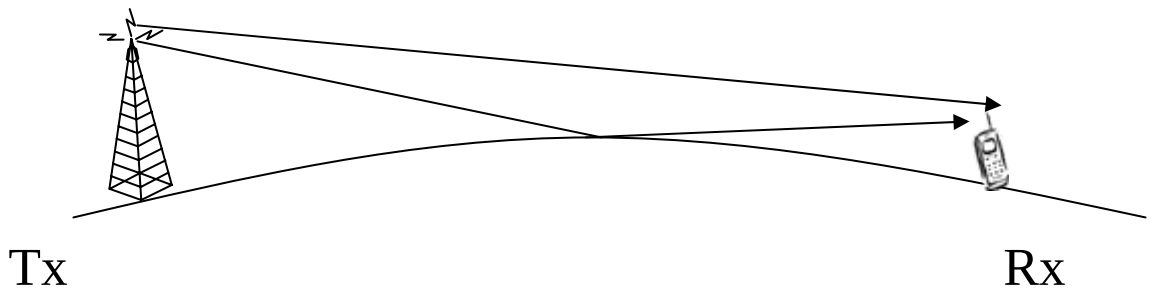
Figure 8.6 Free Space Radiator.

Ground Path Loss

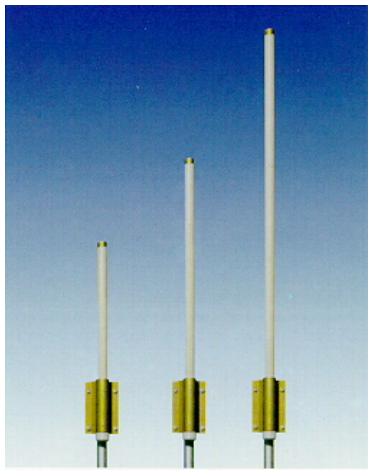
Power density by path loss $\propto \dfrac{h_{Tx}^{\ 2} \times h_{Rx}^{\ 2}}{\lambda^2 \times r^4}$

Accurate model with $r \cong 100m \sim 10km$

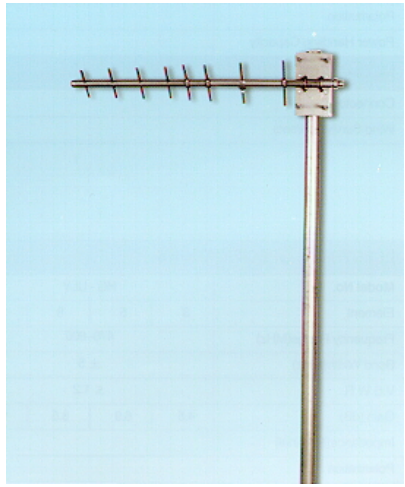
$2.5 \le n \le 5.5$



Antenna- redirect and focus the power



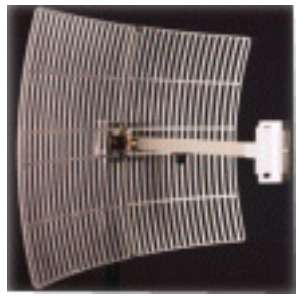
Omni-directional Antenna



Yaggi Antenna

Parabolic Dish Antenna

Horn Antenna



Grid Antenna

Effect of Antenna

$$G = \frac{power - density - with - antenna}{power - density - of - isotrophic - antenna}$$

$$A_{eff}=(\lambda^2/4\pi)\, G_{Tx}\, G_{Rx}$$

$$P_r=P_t\, A_{eff}\, \text{Path loss}$$

$$P_r=P_t + L_r + G_t + G_r - 40 \log r + 20 \log h_t + 20 \log h_r + F_s + F_f$$

$$P_r= P_t \{(L_r G_t G_r h_t^2 h_r^2)/r^4\} F_s\, F_f$$

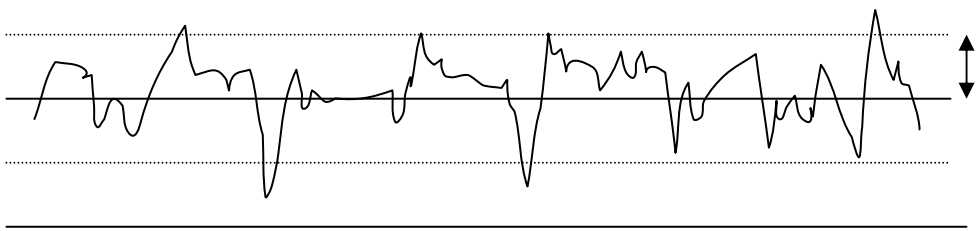
Effect of Antenna

Received signal power ≥ Receiver sensitivity
i.e. Noise Floor

Typical receiver sensitivity = ≅ -100dBm

Enemies of Signal

Noise	Distortion	Attenuation
Man-made	Log-normal shadowing	Path loss
Natural	Rayleigh	Antenna cabling
Thermal	Doppler	
⇩	⇩	⇩
Set the Noise Floor	Increase the signal variability	Lower signal Strength



Average signal level - Signal variability > Noise + Interference