Fact Sheet Chapter 3

Friis TX Eq

$$P_r(d) = \frac{P_t G_t G_r \lambda^2}{(4\pi)^2 d^2 L} = \frac{|E|^2}{120\pi} A_e$$

↑ Loss Factor

$$EIRP = P_t G_t$$

Path Loss

$$PL(dB) = 10 \log \frac{P_t}{P_r}$$

Reflection

See Fig 3.4

$$\Gamma_{\parallel} = \frac{-\varepsilon_r \sin\theta_i + \sqrt{\varepsilon_r - \cos^2\theta_i}}{\varepsilon_r \sin\theta_i + \sqrt{\varepsilon_r - \cos^2\theta_i}} \qquad \theta_i = \theta_r$$

$$\Gamma_{\perp} = \frac{\sin\theta_i - \sqrt{\varepsilon_r - \cos^2\theta_i}}{\sin\theta_i + \sqrt{\varepsilon_r - \cos^2\theta_i}}$$

Ground Bounce

$$E_{TOT}(d) \cong \frac{2 E_0 d_0 \, 2\pi h_t h_r}{d^2 \lambda} \quad \left(\frac{V}{m}\right)$$

$$P_r = P_t G_t G_r \frac{h_t^2 h_r^2}{d^4}$$

Diffraction

$$v = h\sqrt{\frac{2(d_1+d_2)}{\lambda d_1 + d_2}} \qquad \phi = \frac{\pi}{2} v^2$$

r_n = radius of Fresnel zones $= \sqrt{\dfrac{n \lambda d_1 d_2}{d_1 + d_2}}$ $\qquad n = 0, 1, 2 \ldots$

Rough Surface Scattering

$$h_c = \frac{\lambda}{8\sin\theta_i} \qquad \rho_s = \exp\left(-8\left(\frac{\pi\sigma_h\sin\theta_i}{\lambda}\right)\right)$$

$$\Gamma_s = \rho_s\Gamma$$

Log-distance Path Loss

$$P_r = P_0\left(\frac{d}{d_0}\right)^{-n} \quad \Big\| \quad \overline{PL}(d) = \overline{PL}(d_0) + 10n\log\left(\frac{d}{d_0}\right)$$

Table 3.2 for n

Okumura model

$$L_{50}(dB) = L_F + A_{mu} - G(h_{te}) - G(h_{re}) - G_{AREA}$$

$$G(h_{te}) = 20\log(h_{te}/200)$$

$$G(h_{re}) = 10\log(h_{re}/3) \qquad h_{re} \le 3m$$

$$G(h_{re}) = 20\log(h_{re}/3) \qquad 10m > h_{re} > 3m$$

Figures 3.23 + 3.24

Hata Model

See text