

ITS323 – Transmission Media Notes

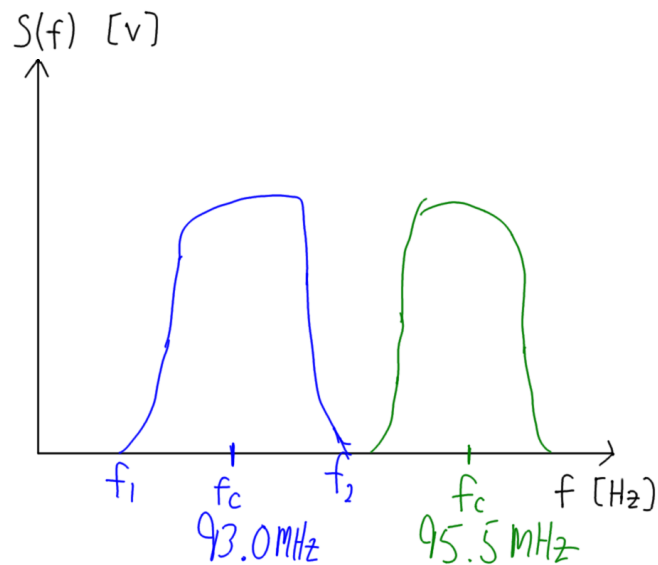


Figure 1: Signals at different centre frequencies (channels); Lecture 11

Twisted pair : $0 \rightarrow 100$ MHz
 $B \approx 100$ MHz

Optical fibre : $10^{14} \rightarrow 10^{15}$ Hz
 $B \approx 10^{15}$ Hz
 $= 10,000,000 \times \text{TP}$

Coaxial cable : $10^3 \rightarrow 10^9$ Hz
 $B \approx 1$ GHz

Figure 2: Bandwidth of twisted pair, coaxial cable and optical fibre; Lecture 11

$$\begin{aligned}
 5 \mu\text{s}/\text{km} &= 5 \mu\text{s} / 1000 \text{m} \\
 &= 0.005 \mu\text{s} / \text{m} \\
 &= 5 \text{ns} / \text{m} \\
 &200,000,000 \text{ m/s}
 \end{aligned}$$

Figure 3: Propagation speed in cables; Lecture 11

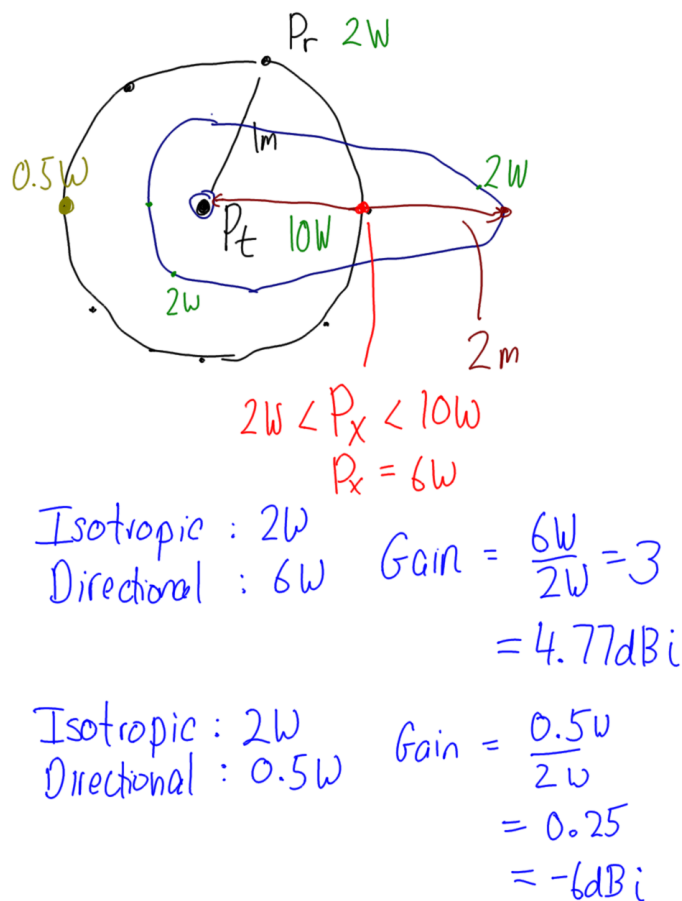


Figure 4: Antenna gain vs isotropic antenna; Lecture 12

Parabolic dish antenna

$$r = 0.5 \text{ m}$$

$$A = \pi r^2 = \pi \times (0.5)^2$$

$$A_e = \underline{0.5} \times A$$

$$= 0.5 \times \pi \times (0.5)^2$$

$$G = \frac{4\pi A_e}{\lambda^2} \quad f = 5 \text{ GHz}$$

$$= 1370 \quad \lambda = \frac{3 \times 10^8}{5 \times 10^9}$$

$$= 31.36 \text{ dBi}$$

Figure 5: Antenna gain of a parabolic antenna; Lecture 12

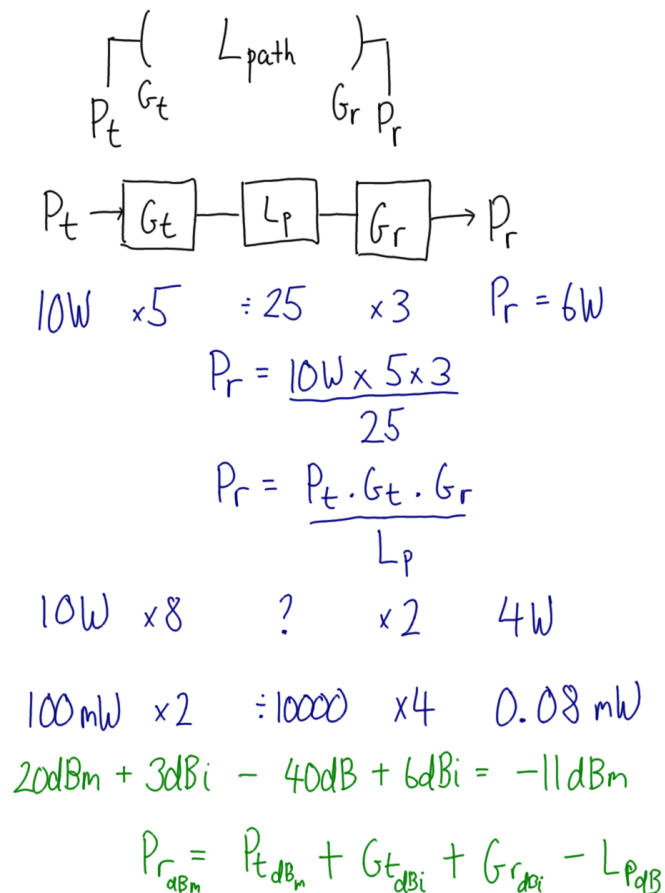


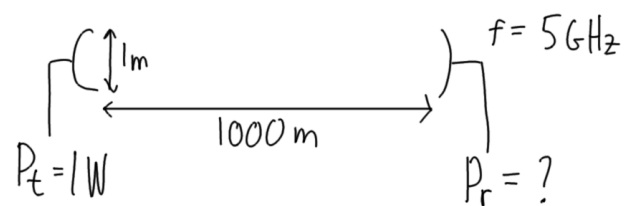
Figure 6: Path Loss Model using Factors and dB; Lecture 13

$$\begin{aligned}
 & 23\text{dBm} \quad 2\text{dBi} \quad ? \quad 2\text{dBi} \quad -71\text{dBm} \\
 & L_{\text{pdB}} = 23 + 2 + 2 - (-71) \\
 & \quad \quad \quad = 98\text{dB} \\
 & 23 + 2 - 92 + 2 = \rightarrow -65\text{dBm} \quad \checkmark \\
 & \quad \quad \quad \text{----- receive threshold} \\
 & 23 + 2 - 100 + 2 = \rightarrow -73\text{dBm} \quad \times \quad -71\text{dBm} \\
 & L_p = \frac{(4\pi d)^2}{\lambda^2} \quad \lambda = \frac{c}{f} = \frac{3 \times 10^8}{5 \times 10^9} = 0.06\text{m} \\
 & L_{\text{pdB}} = 98\text{dB} \quad L_p = 10^{9.8} \\
 & 10^{9.8} = \frac{(4\pi d)^2}{(0.06)^2} \\
 & \therefore d = 379\text{m}
 \end{aligned}$$

Figure 7: Path Loss and Receive Sensitivity; Lecture 13

$$P_r = \frac{P_t G_t G_r}{(4\pi d)^2 / \lambda^2} = \frac{P_t G_t G_r \lambda^2}{(4\pi d)^2}$$

Figure 8: Free Space Path Loss Equation; Lecture 13



$$A_e = 0.5 \times \text{area of circle}$$

$$= 0.5 \times \pi \times (0.5)^2 \text{ m}^2$$

$$\lambda = \frac{3 \times 10^8}{5 \times 10^9} = 0.06 \text{ m}$$

$$G_t = \frac{4\pi \times A_e}{\lambda^2} = 1370 = 31.4 \text{ dBi}$$

$$G_r = 1370$$

$$P_r = \frac{P_t G_t G_r \lambda^2}{(4\pi d)^2} = 0.0428 \text{ mW}$$

Figure 9: Free Space Path Loss Example; Lecture 13