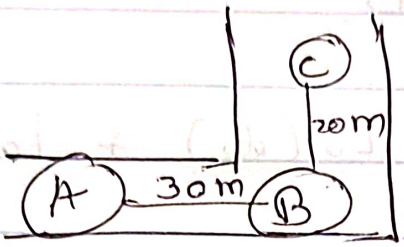
01597109 Patel Meet

HW-2 Task-1



$P_S = 10^{-3}$ W $pL_0(d_0) = 20$ db.

$d_0 = 1$ m.

$\alpha = 2.8$

$\frac{N_0}{2} = 4 \times 10^{-21}$ W/Hz.

$\Downarrow$.

$N_0 = 8 \times 10^{-21}$ W/Hz

Bandwidth $W = 10$ MHz $= 10^7$ Hz

Capacity of channel

$C = W \log_2 (1 + SINR)$

$\Rightarrow$ Signal to Noise Ratio

$$SINR = \frac{P}{I + N_0 W} = \frac{P}{N_0 W}$$

(∵ no interference)

(Q)

Link A – B.

$$P_L(B) = P_{L_0}(d_0) + 10\alpha \log_{10}\left(\frac{d_{AB}}{d_0}\right)$$

$$= 20 + 10\,(2.8)\log_{10}(30)$$

$$= 61.36\ dB$$

Power received.

At B

$$P_r(B) = P_L(B) = 10\log_{10}\left(\frac{P_S}{P_r(B)}\right)$$

$$\frac{P_S}{P_r(B)} = 10^{\frac{P_L(B)}{10}}$$

$$\Rightarrow P_r(B) = P_{SB} \times 10^{-\frac{P_L(B)}{10}}$$

$$P_r(B) = 10^{-3} \times 10^{-6.136}$$

$$= 10^{-9.136}$$

$$P_r(B) = 73.1\ nW$$

$$SINR = \frac{P_R(B)}{N_0 W} = \frac{7.31 \times 10^{-10}}{8 \times 10^{-4} \times 10^{7}}$$

$$= 9.13875 \times 10^{-3}$$

$$C_{AB} = W \log_2 (1 + SINR)$$

$$= 10^7 \log_2 (1 + 9138.75)$$

$$C_{AB} = 131.58 \text{ Mbps}$$

For Link (B <-> C)

$$PL_{BC} = PL_0(d_0) + 10\alpha \log \left(\frac{d_{BC}}{d_0} \right)$$

$$= 20 + 10(2.8) \log_{10}(20)$$

$$= 56.43 \text{ dB}$$

$$P_{R(C)} = P_{SB} \times 10^{-\frac{PL_{BC}}{10}}$$

$$= 10^{-3} \times 10^{-5.643}$$

$$= 2.275 \text{ nW}$$

$$SINR = \frac{P_R(c)}{N_0 W}$$

$$= \frac{2.275 \times 10^{-9}}{8 \times 10^{-21} \times 10^{7}}$$

$$= 28.4375 \times 10^{3}$$

$$C_{Bc} = W \log_2 (1 + SINR)$$

$$= 10^{7} \log_2 (1 + 28437.5)$$

$$= 147.96 \times 10^{6} \text{ bps}$$

$$C_{Bc} = 147.96 \text{ mbps}$$

HP - Task-1

Max throughput

$C_{AB} = 131.58 \times 10^6$ bps

$C_{BC} = 147.96 \times 10^6$ bps

$C_{ABC} = ?$

assuming transmitting 1 bit from A → B → C

time taken to transmit for A → B = t_{AB}

" " " B → C = t_{BC}

$$t_{AB} = \frac{1}{C_{AB}}, \quad t_{BC} = \frac{1}{C_{BC}}$$

$$t_{ABC} = \frac{t}{AB} + \frac{t}{BC}$$

To transmit 1 bit over A → B → C it take t_{ABC} time.

Hence, per second we can transmit $\frac{1}{t_{ABC}}$

$$C_{ABC} = \frac{1}{t_{ABC}}$$

$$= \frac{C_{AB} \times C_{BC}}{C_{AB} + C_{BC}}$$

$$= 10^8 / (0.76 + 0.68)$$

$$C_{ABC} = 69.4 \text{ MBPS}.$$