

# Principles of Communications Networks

## Homework Assignment 4

Due date: 2020/5/27 (Wednesday) 6pm

Note: 請用 A4 空白影印紙作答，並繳交至助教實驗室(工程三館 446B)

Note: please using A4 copy paper as your answer sheet, and turn in your answer sheet to TAs (EC Building 446B)

For exchange students, please scan your answer sheet and email to TAs.

1. Two adjacent BS  $i$  and  $j$  are 30 km apart. The signal strength received by the MS is given by the following expressions:

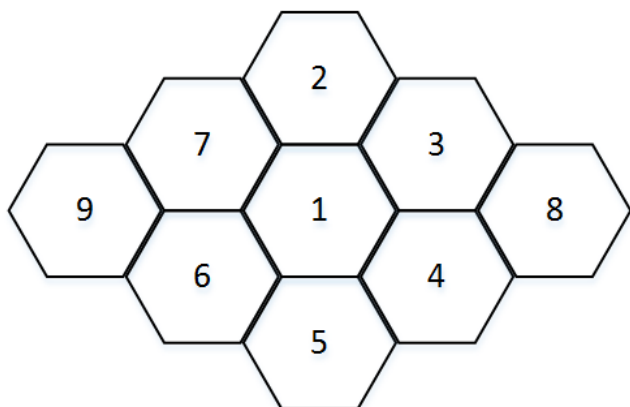
$$P(x) = \frac{G_t G_r P_t}{L(x)},$$

where

$$L(x) = 69.55 + 26.16 \log_{10} f_c(\text{MHz}) - 13.82 \log_{10} h_b(\text{m}) - \alpha [h_m(\text{m})] + [44.9 - 6.55 \log_{10} h_b(\text{m})] \log_{10}(x),$$

and  $x$  is the distance of the MS from BS  $i$ . Assume unity gain for  $G_t$  and  $G_r$ , given that  $P_i(t)=10$  watts,  $P_j(t)=100$  watts,  $f_c = 300$  MHz,  $h_b = 40$  m,  $h_m = 4$  m,  $\alpha = 3.5$ ,  $x = 1$  km, and  $P_j(t)$  is the transmission power of BS  $j$ .

- (a) What is the power transmitted by BS  $j$  so that the MS receives signals of equal strength at  $x$ ?
- (b) If the threshold value  $E = 1$  dB and the distance where handoff is likely to occur is 2 km from BS  $j$ , then what is the power transmitted by BS  $j$ ?
2. If each user keeps a traffic channel busy for an average of 5% time and an average of 60 requests per hour is generated, what is the Erlang value?
3. A cellular scheme employed a cluster of 16 cells. Later on, it was decided to use two different clusters of 7 and 9 cells. Is it possible to replace each original cluster by two new clusters? Please explain clearly.
4. A TDMA-based system, shown below, has a total bandwidth of 12.5 MHz and contains 20 control channels with equal channel spacing of 30 KHz. Here, the area of each cell is equal to  $8 \text{ km}^2$ , and cells are required to cover a total area of  $3,600 \text{ km}^2$ . Calculate the following:
- (a) Number of traffic channels/cell
- (b) Reuse distance



5. For a hexagonal cellular system with radius  $R$ , reuse distance  $D$ , and  $N=4$ , prove  $D = \sqrt{12}R$ . (不能直接帶入公式，請畫圖並逐步證明)