Principles of Communications Networks
Homework Assignment 3

Due date: 2020/5/11 (Monday) 6pm

Note: 請用 A4 空白影印紙做答，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. A radio link uses a pair of 2m dish antennas with an efficiency of 60 percent each, as transmitting and receiving antennas. Other specifications of the link are: transmitted power = 1 dBw, carrier frequency = 4 GHz, distance of the receiver from the transmitter = 150 m. Please calculate:
   (a) The free-space loss;
   (b) The power gain of each antenna; and
   (c) The received power in dBw.
2. $P_r = P_t G_t G_r (\frac{\lambda}{4\pi d})^2$ is one formula of the Friis free-space equation. Show that this equation can be also formulated in the following equivalent forms:
   (a) $P_r = \frac{P_t A_t A_r}{\lambda^2 d^2}$
   (b) $P_r = \frac{P_t A_r G_r}{4\pi d^2}$
   , where P_t is the transmitted power, A_t is the effective area of the transmitting antenna, λ is the carrier wavelength, d is the distance of the receiver from the transmitter, G_r is the power gain of the receiving antenna, A_r is the effective area of the receiving antenna, and P_r is the received power.
3. What cause ISI and how can you reduce ISI in the wireless communication system?
4. What is diversity reception? How can it be used to combat multipath?
5. What does a small delay spread indicate about the characteristics of a fading channel? If the delay spread is 1 ms, will two different frequencies that are 5 MHz apart experience correlated fading?
6. Consider an antenna transmitting at 900 MHz. The receiver is traveling at a speed of 40 km/h. Calculate its Doppler shift.
7. What is the difference between fast fading and slow fading?
8. What's the difference between Rayleigh fading model and Rician fading model?