EE5132 / EE5023 – Wireless and Sensor Networks Part 1: Tutorial 1 – Questions

1. A mobile user travels at 80 km/hr, transmits at a carrier frequency of 850 MHz and experiences Rayleigh fading with a signal-to-fade margin $A^2/(2\sigma^2)$ of 0.01. (Assume $c = 3 \times 10^8$ m/s.)
   (a) Determine the average rate at which the signal envelope falls below the fade margin.
   (b) Determine the average fade duration.
   (c) Determine the average inter-fade duration.
   (d) Determine the received carrier frequency if the mobile is moving directly towards the transmitter.
   (e) For a digital transmission system using QPSK (quadrature phase shift keying) operating at 200 kbits/s, is the Rayleigh fading slow or fast?

2. A mobile transmitter travels at a constant speed of v m/s. It experiences Rayleigh multipath fading. The received signal envelope undergoes 100 fades/s and the normalized fade margin, $A^2/(2\sigma^2)$, is 0.01. Assume that the radio propagation speed is 3×10^8 m/s.
   (a) How fast is the vehicle travelling if the carrier frequency is 1 GHz?
   (b) How fast would the vehicle travel if the average duration that the envelope falls below the fade margin is 10 ms?

3. A mobile terminal MT_A traverses a path as shown in Figure Q3 at a speed of 15 m/s. The arc represents the cell boundary within which the mobile terminal will be serviced by base station BS_B. The radio channel operates at a carrier frequency of 2 GHz, the speed of radio propagation is 3×10^8 m/s, and the normalized fade margin $A^2/(2\sigma^2)$ is 0.01.
   (a) When do you encounter the maximum fade level crossing rate?
   (b) Determine the maximum fade level crossing rate.

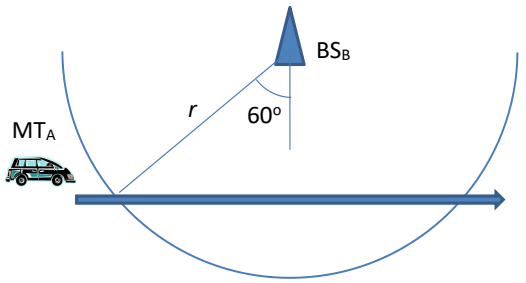

Figure Q3

4. The mean delay spread in a particular environment is 1.5μs. What is the maximum symbol rate before intersymbol interference renders communications impossible?

5. A mobile radio user travels at 20 m/s and communicates at a carrier frequency of 2 GHz. The speed of light is 3×10^8 m/s and the normalised fade margin, $A^2/(2\sigma^2)$, is 0.01.
   (a) Determine the probability that the received signal is in a fade.
   (b) If the user moves at a slower speed, will the probability of being in a fade increase or decrease?