Rayleigh Fading

- Example: Average power is 1 W. What is the probability that the signal amplitude falls below 1?
- Recall Eq. 9 from last week's notes

(Eq. 1)

Flat vs. frequency-selective fading

- How different is fading from frequency to frequency?
- Recall Eq. 3 from last week's notes

(Eq. 2)

- if d_1-d_2 is large, a small change in frequency will have a huge effect (frequency-selective fading)
- on the other hand if d_1-d_2 is small, a small change in frequency will have a negligible effect (flat fading)
- note that $(d_1-d_2)/c$ is equal to the time delay of arrival between the two signals, so if $B(d_1-d_2)/c$ is small, then fading is flat
- $(d_1-d_2)/c$, or maximum delay between first and last significant paths, is called the delay spread

Effect of Motion on Wireless Communication

- Suppose the transmitter antenna is stationary, while the receiver antenna is mounted on a moving vehicle
- Rx antenna starts out at distance d and moves at a velocity of v with respect to tx

- Pure sinusoid is transmitted at carrier frequency f_c

(Fig. 1)

- Signal is now

(Eq. 3)

- collecting terms

(Eq. 4)

- The frequency $f_c v/c$ is called the Doppler frequency – arises from the doppler effect
- Causes periodic dropouts in signal strength if compensation is not used in the receiver

(Eq. 5)

Example. $f_c = 1$ GHz, v = 108 km/hr

- Causes periodic dropouts in signal strength in multipath
- Say two paths exist, one stationary and the other in motion

(Fig. 2)

- Received signal is now

(Eq. 6)

Example. f_c = 1 GHz; one path stationary: d_1 = 100m; second path moving: d_2 = 100m initially, v = 54 km/hr