Diversity

Exercise 1: Which of these might lead to a reduction in system efficiency by requiring more time or bandwidth? Which of these would require additional or more complex antennas?

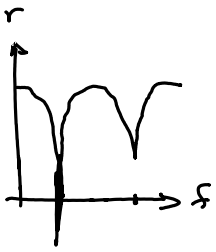
	requires more time	requires more bandwidth	requires more hardware
time	Y	N	N
frequency	N	Y	Y
space	N	N	Y
polarization	N	N	Y

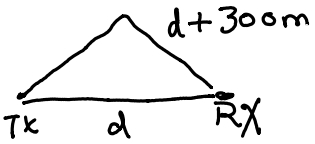
Exercise 2: What spacing is required for 10λ separation at 900 MHz?

$$\lambda = \frac{c}{f} = \frac{3 \times 10^8}{9 \times 10^8} = 33 \text{ cm.}$$

$$10\lambda \approx 3 \text{ m.}$$

Exercise 3: How far apart would the frequency nulls be for a channel with two equal-gain paths with path lengths that differ by 300m? By 30m? What time delay differences does this correspond to?





for cancellation (null)

$300m = \frac{\lambda}{2} \cdot n \qquad n = 1, 3, 5 \ldots$

to get 180° phase shift

$300 = \frac{c}{2f} n$

$f = \frac{c}{2 \cdot 300} n = \frac{3 \times 10^8}{2 \cdot 3 \times 10^2} n = 0.5 \times 10^6 n$ for n odd

$\therefore f = 0.5, 1.5, 2.5, \ldots$ MHz $\Rightarrow$ every 1 MHz.

similarly for path length difference = 10m

$\Rightarrow$ every 10 MHz

$300m \Rightarrow \frac{3 \times 10^2 \ m}{3 \times 10^8 \ m/s} = 1 \mu s. \qquad 30m \Rightarrow 100 ns$

Exercise 4: Would time diversity be more or less effective as the receiver's speed increased? What would happen if the receiver was stopped (such as a traffic light)?

- more effective @ higher speeds.
- no fading if interacting objects stationary

but... probably yes there would be fading due to other objects moving.

Exercise 5: What type of diversity would you expect to be implemented in an (inexpensive) WLAN card? In a cellular base station?

WLAN (inexpensive) → switching

cellular base station (performance) → maximal ratio combining.