Principles of Ad Hoc Networking - Solutions to Exercises

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Chapter 1

Exercise 1

The radio uses conventional non quadrature mixing, as modeled by Equation **??**. If we set $f_c = 237.35$ and $f_{lo} = 226.55$, the radio actually picks the signal at the image frequency 215.75 Mega Hertz.

Exercise 2

The Equation 1.5 is the Equation 1.4 with the terms $e^{j2\pi(f_c+f_{lo})t}$ and $e^{-j2\pi(f_c+f_{lo})t}$ low pass filtered. Regarding Equation 1.6,

$$\left(\frac{e^{j2\pi f_c t} + e^{-j2\pi f_c t}}{2}\right)\left(\frac{e^{-j2\pi f_{lo} t} - e^{j2\pi f_{lo} t}}{2}\right)$$

is equal to:

$$\frac{j}{4}\left(e^{j2\pi(f_c-f_{lo})t} - e^{-j2\pi(f_c-f_{lo})t}\right)$$

after low pass filtering of the terms $-e^{j2\pi(f_c+f_{lo})t}$ and $e^{-j2\pi(f_c+f_{lo})t}$.

Exercise 3

The event rate is:

$$r \;=\; \frac{f_s}{2^{k-1}} \;\text{ events/s.} = \frac{44,100 \text{ samples/second}}{2^{11} \text{ samples/event}} = \; 21.53 \text{ events/second}$$

Each event should be processed within a delay:

$$d \;=\; \frac{1}{r} \text{ second} = \; 46.4 \text{ milli second}$$

The delay before playback is started is therefore at least $4d = 4 \times 46.4 = 185.6$ milli second.

Exercise 4

$$d \;=\; \frac{\lambda 10^{L/20}}{4\pi}$$

Exercise 5

- 802.11 BreezeNet: 1122 m
- 802.11b: 2818 m
- 802.11a: 412 m
- Bleutooth: 316 m

Exercise 6

At 2.4 Giga Hertz, the wavelength λ is equal to $\frac{300{,}000\ Km}{2.4\ Giga\ Hertz}$. Free space loss therefore corresponds to:

$$10\ log_{10}\left(\frac{4\pi d \times 10^3 \times 2.4 \times 10^9}{3 \times 10^8}\right)^2$$

which is equivalent to:

$$2 \times 10\left[log_{10}\left(\frac{4\pi \times 2.4 \times 10^4}{3}\right) + log_{10} d\right]$$

which is equivalent to:

$$20\left[5 + log_{10} d\right]$$

which is equivalent to:

$$100 + 20 log_{10} d$$