

CS 598 WSI: LECTURE 10

- DEMO
- DISTANCE MEASUREMENTS
- CFO & PACKET DETECTION DELAY
- WITRACK.

DISTANCE MEASUREMENT

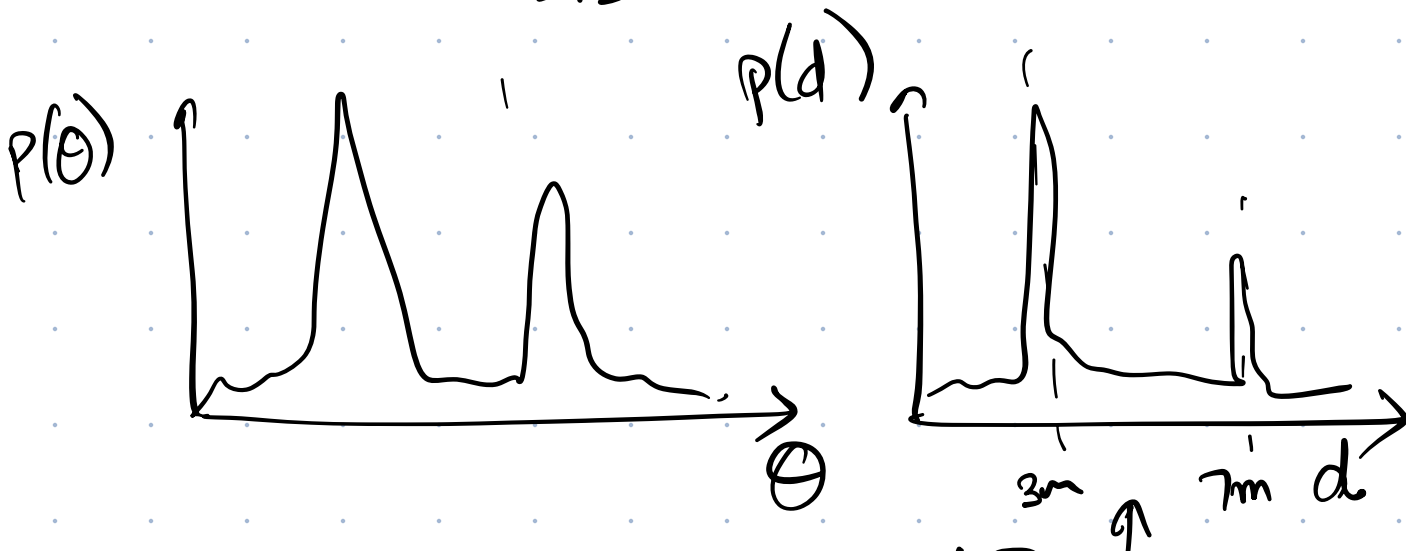
AOA \Rightarrow Measuring phase on different antennas.

Distance \Rightarrow Measuring phase on different frequencies/wavelengths.

$$\angle h = \frac{2\pi}{\lambda} d \pmod{2\pi}$$

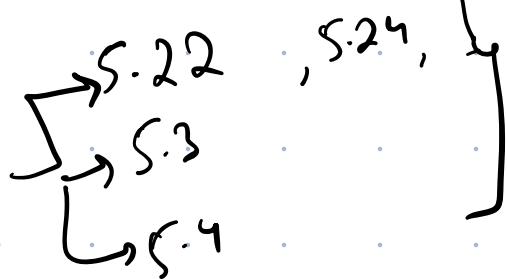
$$\angle h_1 = \frac{2\pi}{\lambda_1} d \pmod{2\pi}$$

$$\angle h_2 = \frac{2\pi}{\lambda_2} d \pmod{2\pi}$$



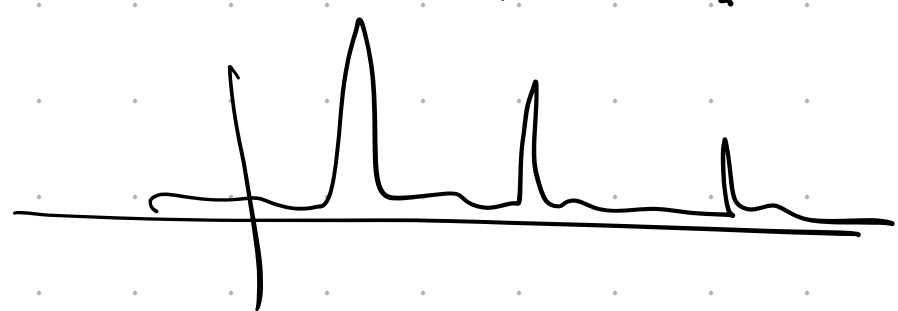
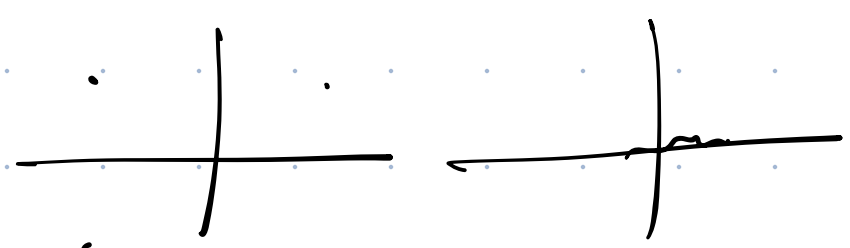
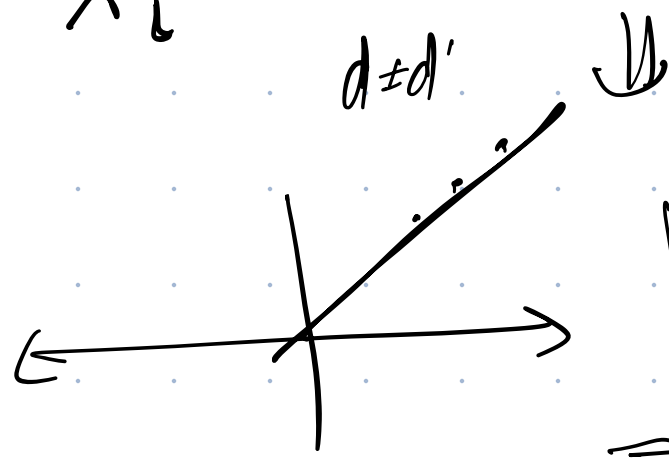
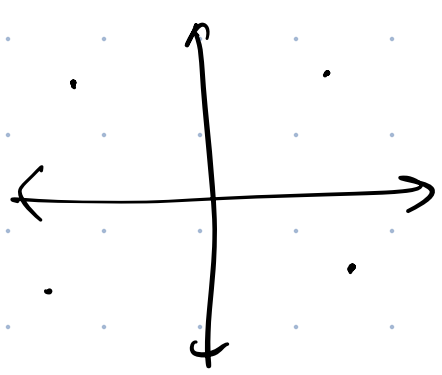
$$h_i = a_i e^{-j \frac{2\pi}{\lambda_i} d'}$$

Wi-Fi
5GHz
band

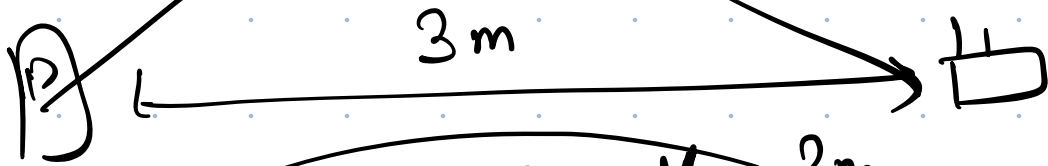


distance
when your
signal is
coming from

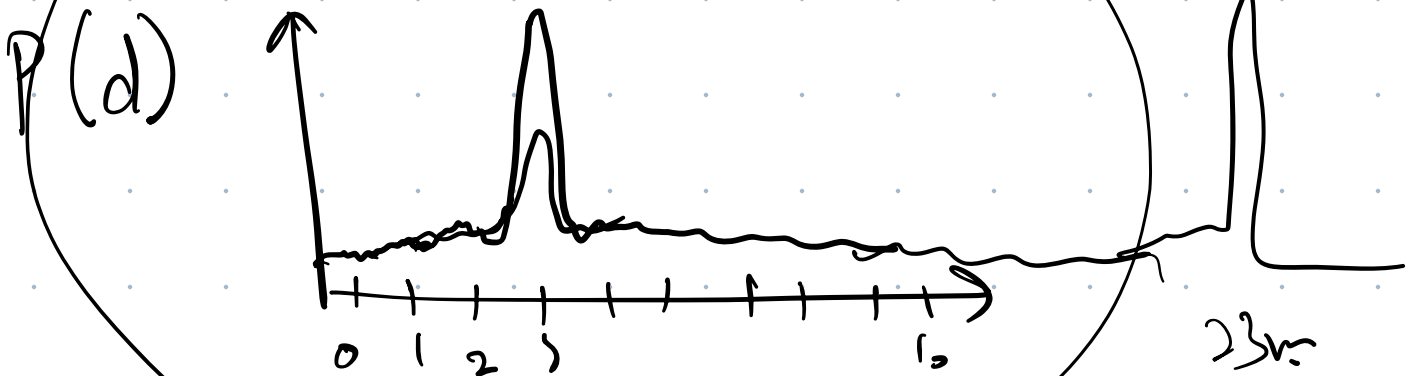
$$P(d) = \sum_{\lambda_i} h_i e^{j \frac{2\pi}{\lambda_i} d}$$



~~7m.~~

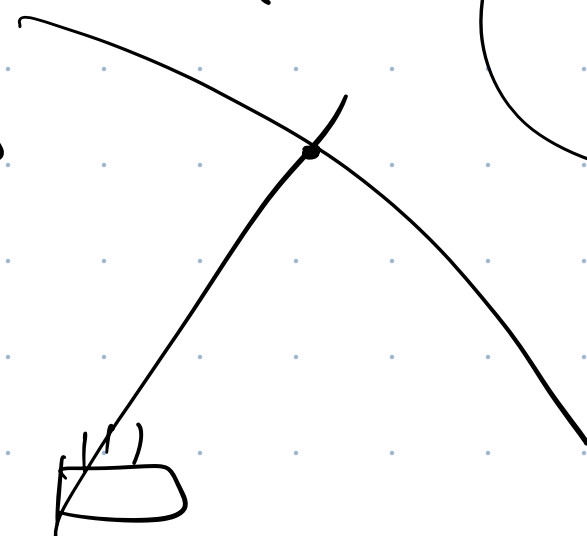
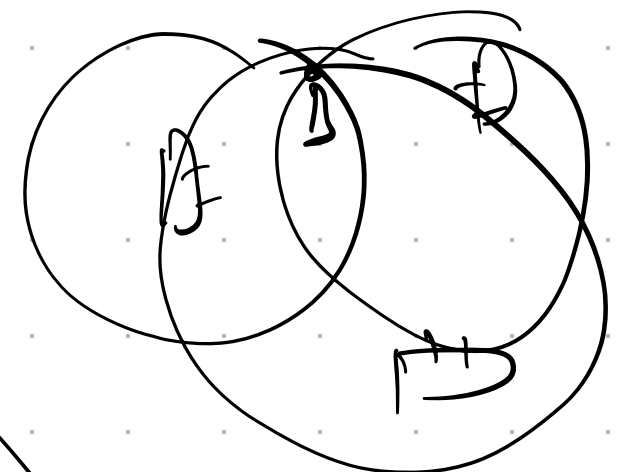
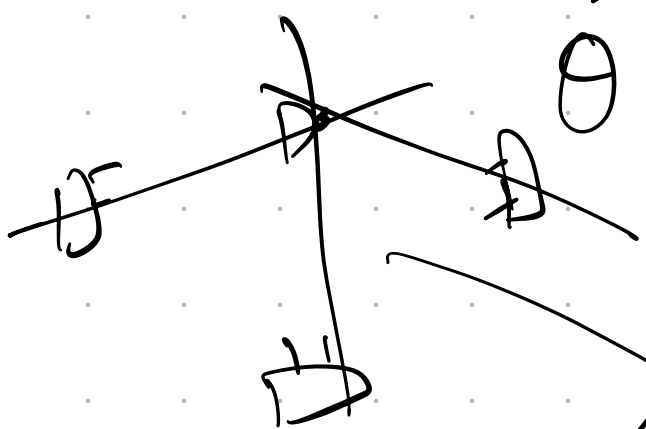
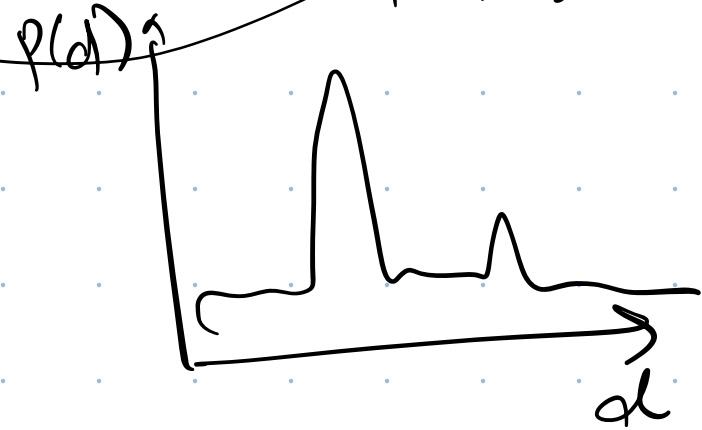
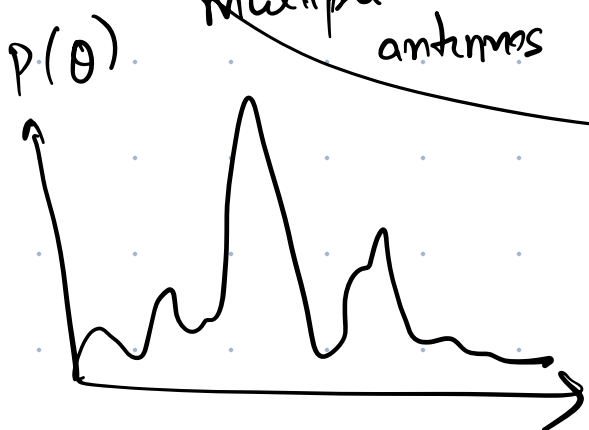


$$h_i = a_i e^{-j \frac{2\pi}{\lambda_i} d_i} \approx 3m$$

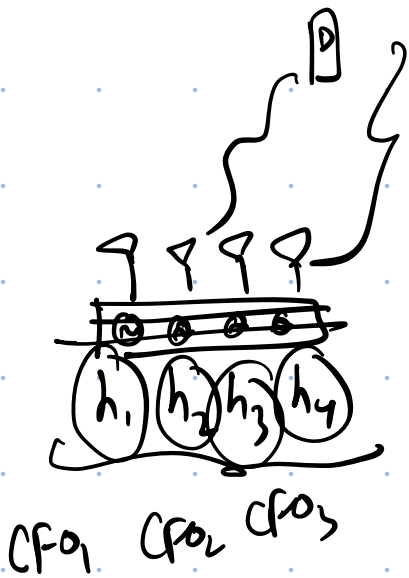


multiple antennas

multiple frequencies

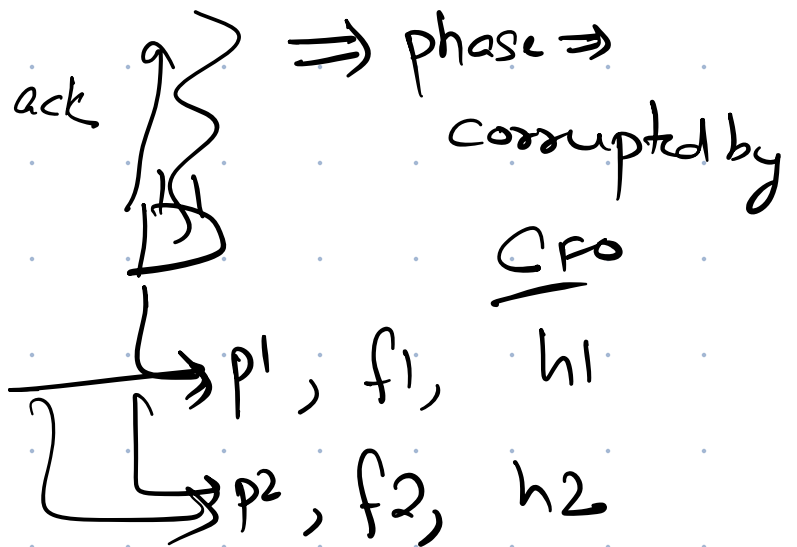


CFO ERRORS



Distance

Δ phase for the ack

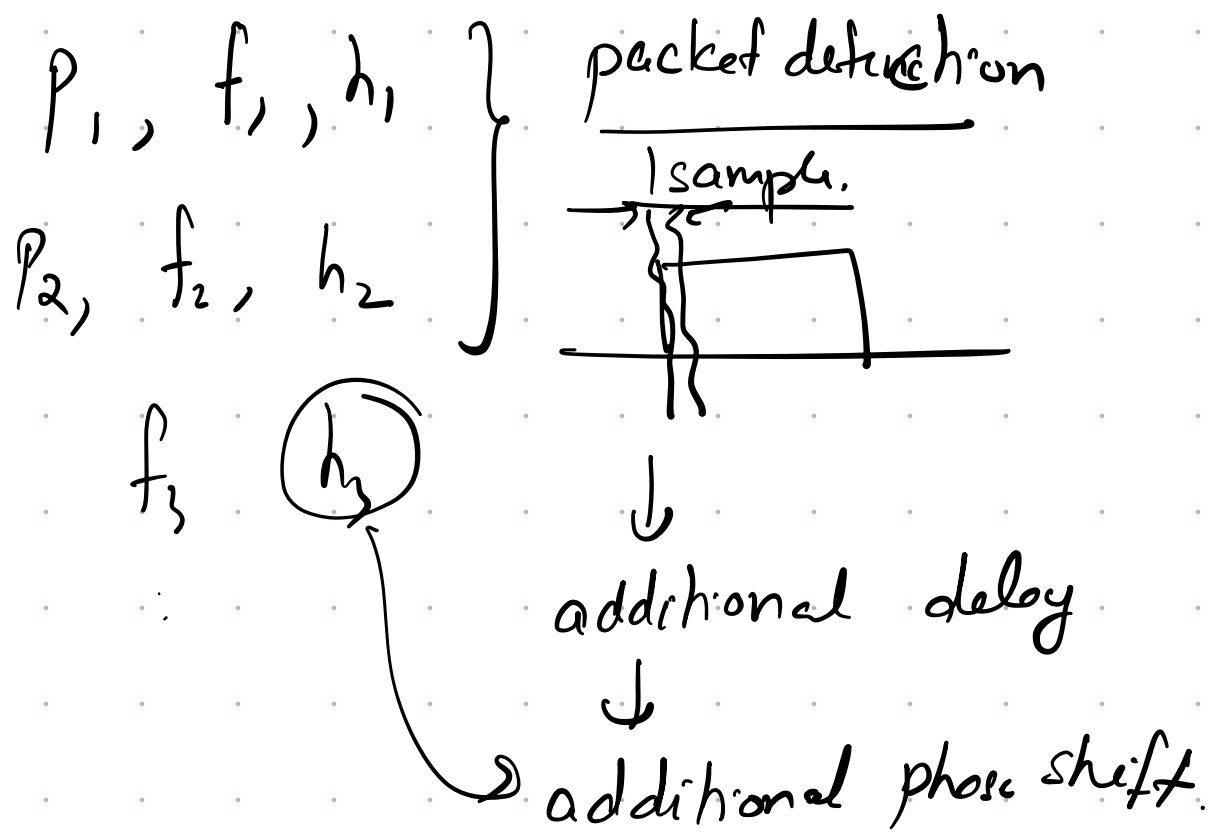


$$\left. \begin{aligned} \text{packet} &= CFO \text{ is } \Delta f \\ \text{ack} &= CFO \text{ is } -\Delta f \end{aligned} \right\}$$

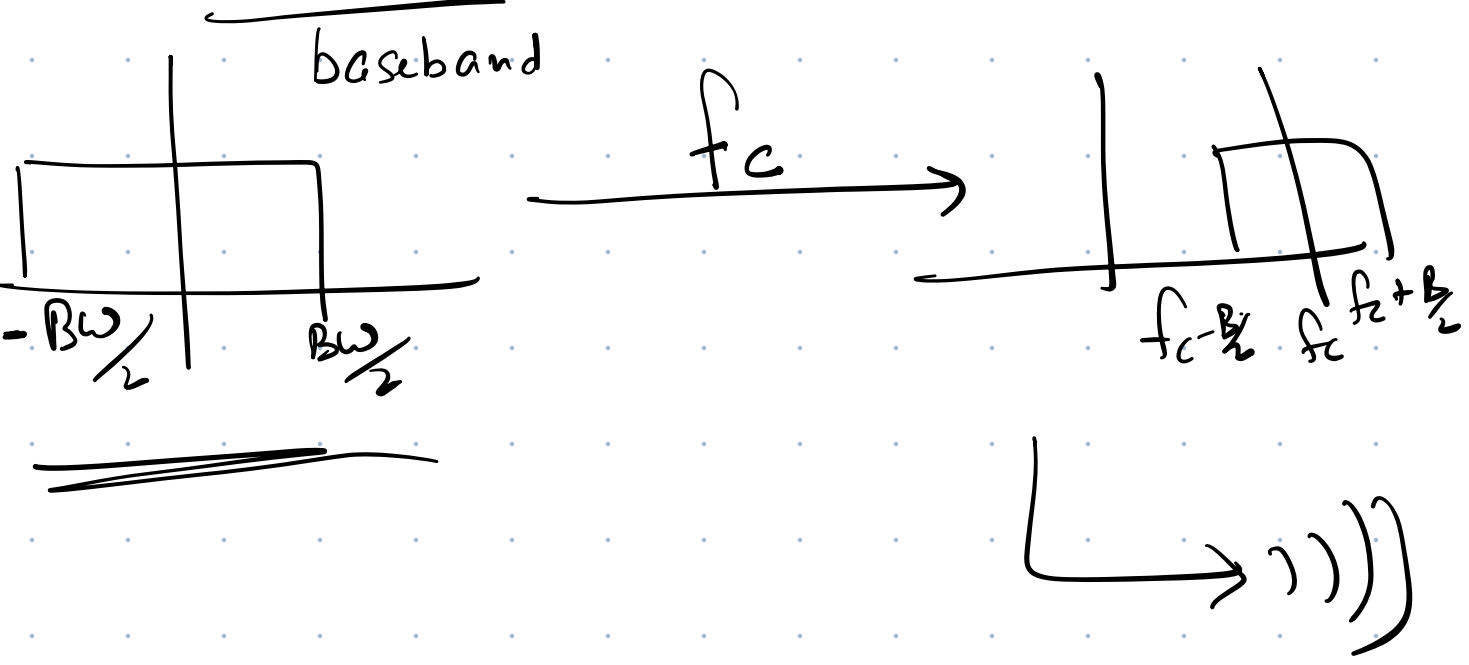
$$\begin{aligned} \angle h_{\text{packet}} &= \phi_{\text{true phase}} + \phi_{CFO} \\ \angle h_{\text{ack}} &= \phi_{\text{true phase}} - \phi_{CFO} \end{aligned}$$

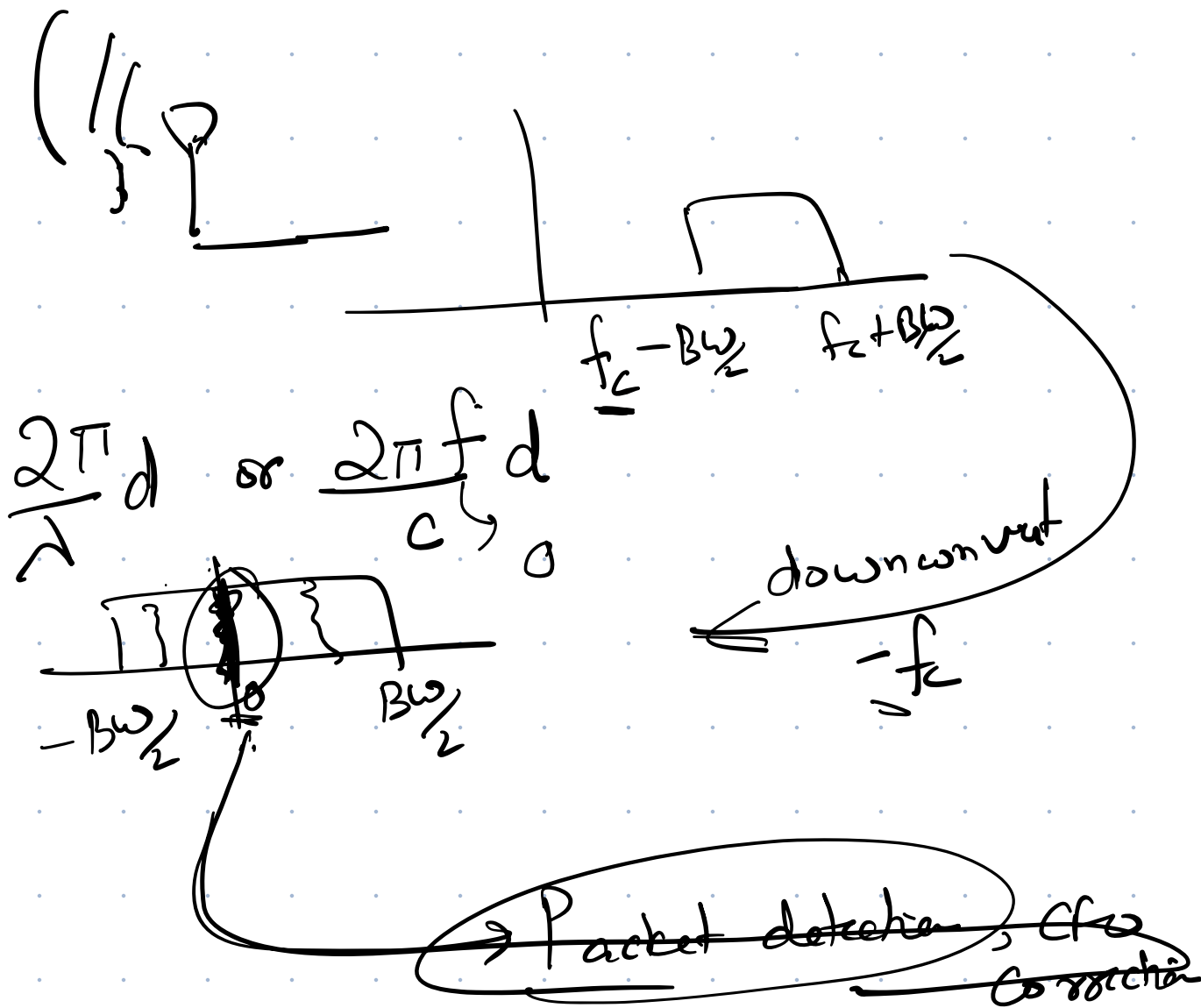
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PACKET DETECTION



OFDM





phase at center freq. is not impacted by digital processing