CS 598 WSI, LECTURE 5

- Narrowband vs. wideband channel
- OFDM: Motivation
- OFDM: Transmitter
- OFDM: Receiver

NARROWBAND vs. WIDEBAND

Bandwidth / Symbols/s.

Wideband ⇒ ↑ bandwidth

⇓

↑ datarate

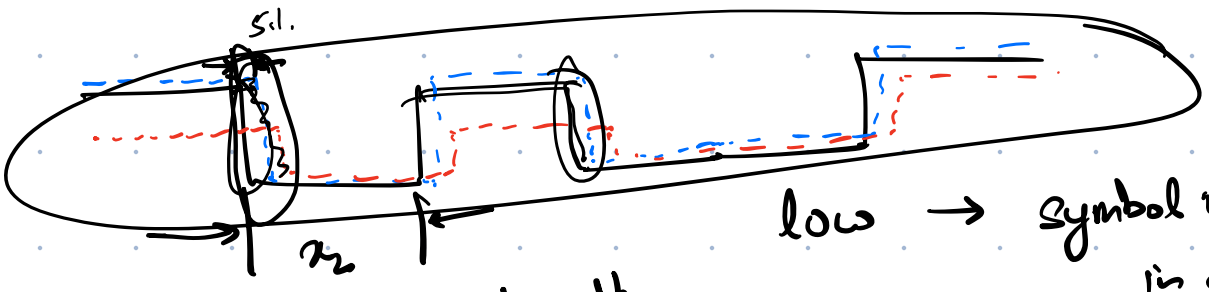
Capacity = BW log (1+SNR)

↳ bandwidth.

Inter-symbol Interference (ISI)

$x_1, x_2, \ldots x_{100}$

1ms 10µs ≈ 1%



↳ bandwidth

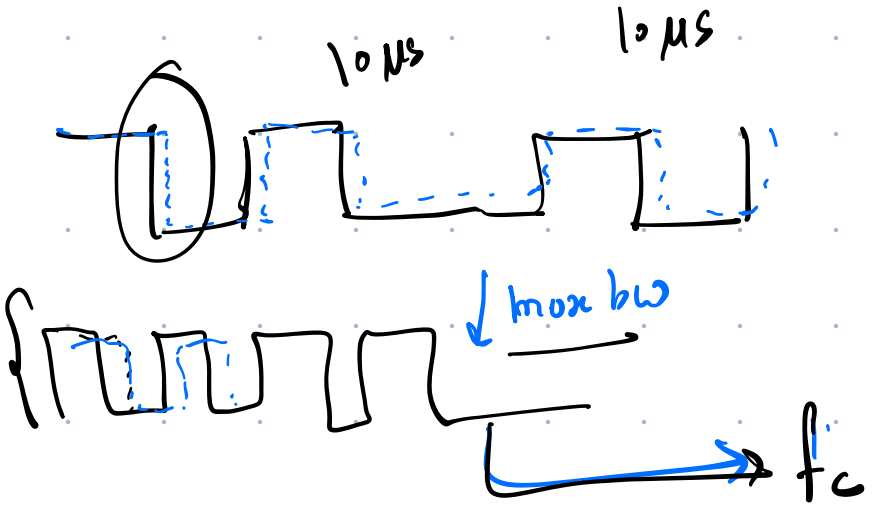
low → symbol is longer in time

1000 → 1ms

10000 → 0.01ms

ISI

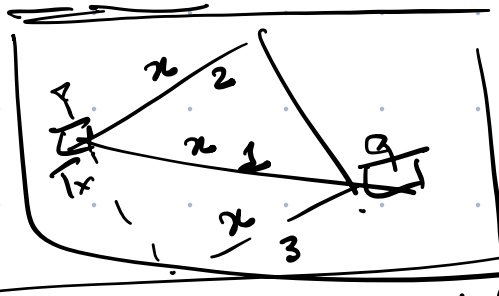
for smaller the symbol ⟹ more the confusion due to ISI



CHANNEL

$$y = hx + n$$

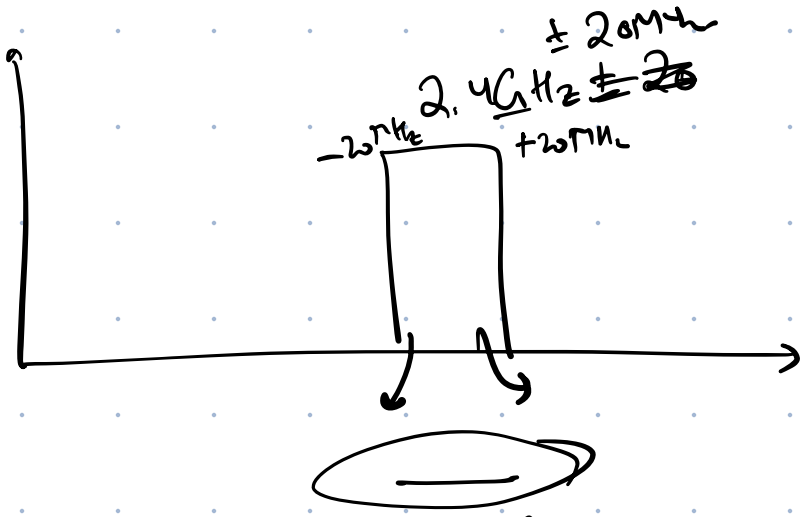
(Rx, Tx, noise)

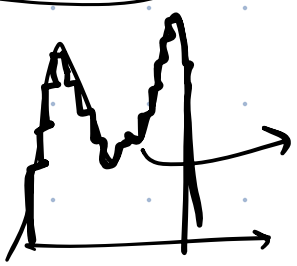


$$y(t) = h_1 x(t - \tau_1) + h_2 x(t - \tau_2) + h_3 x(t - \tau_3)$$

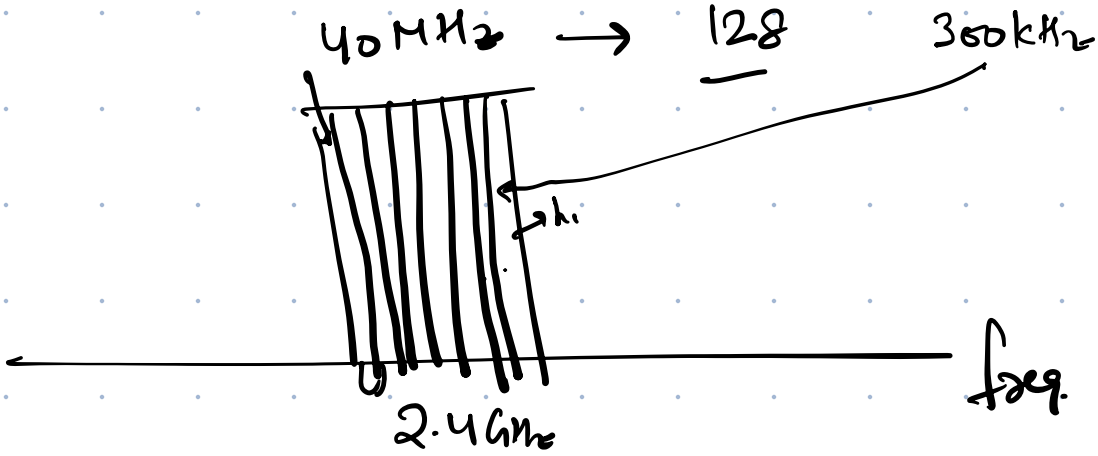
(τ: delay of path)

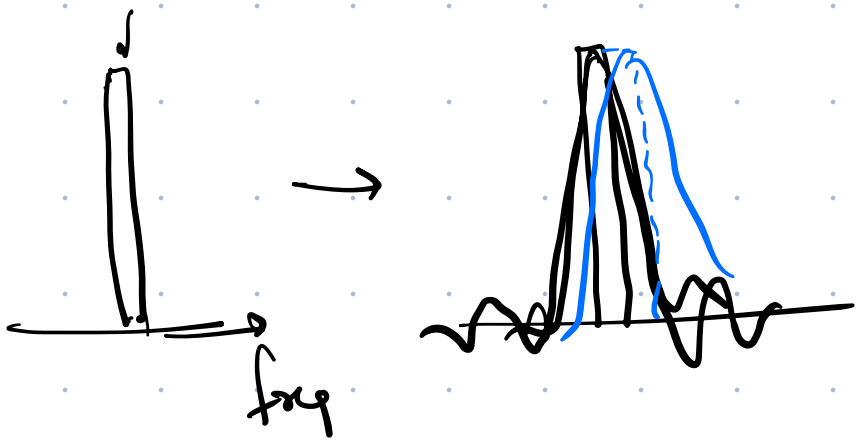
Wideband channel → occupies more spectrum / frequencies



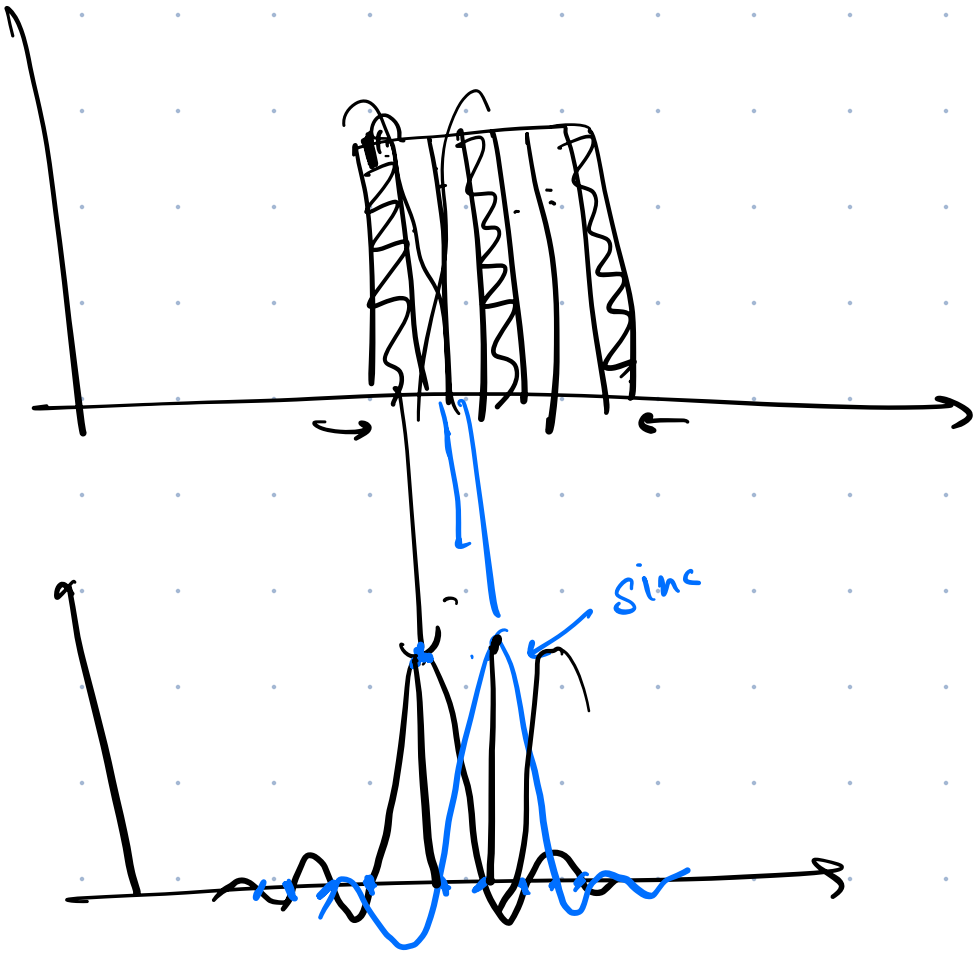


multipath fading





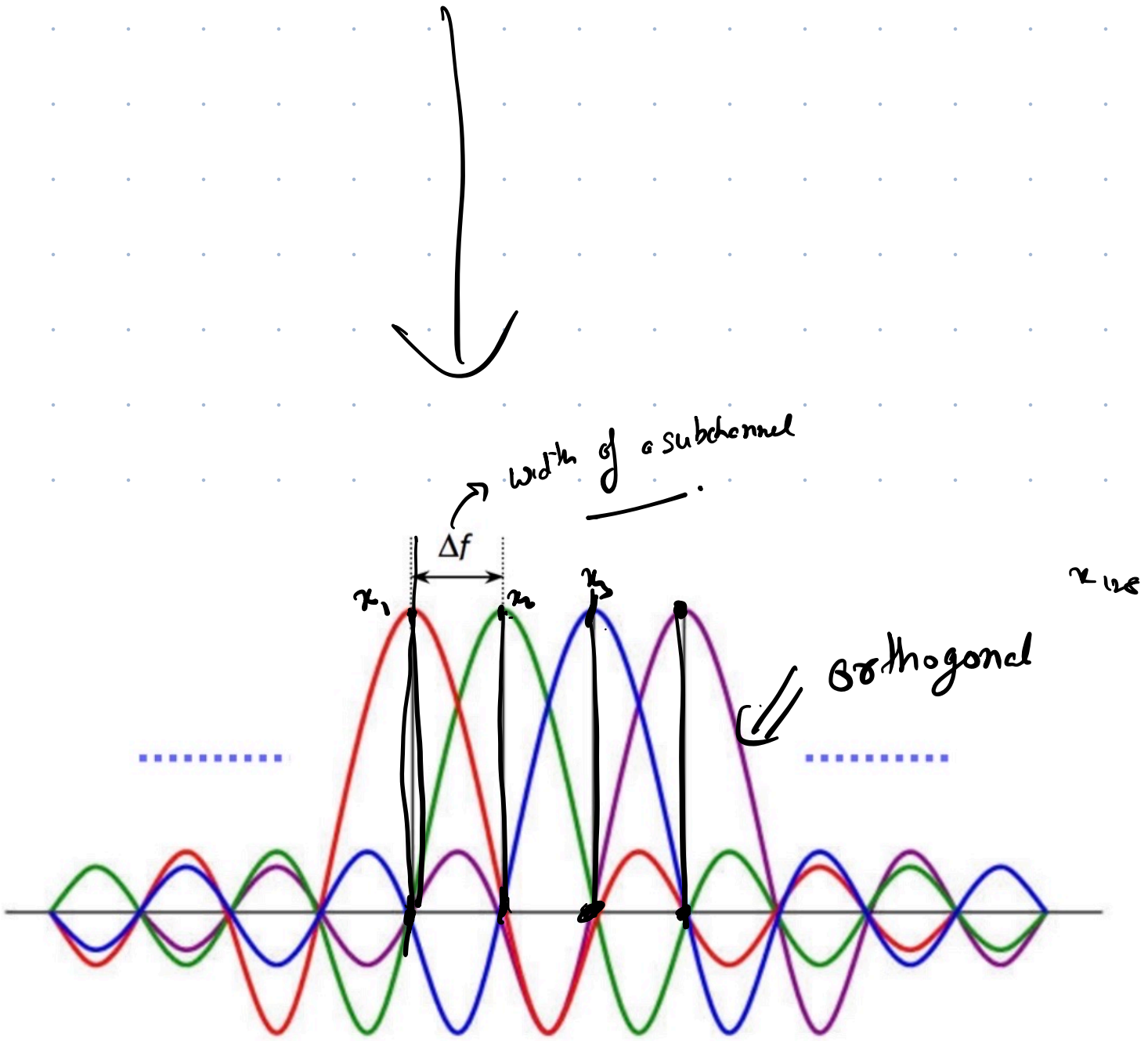
MULTIPLE NARROW BAND



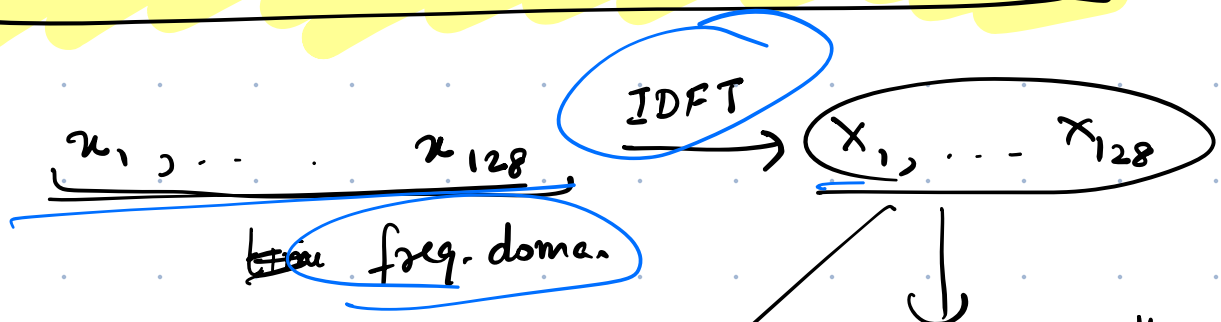
OFDM: MOTIVATION

DFT | Discrete Fourier Transform.

time domain ⟷ frequency domain



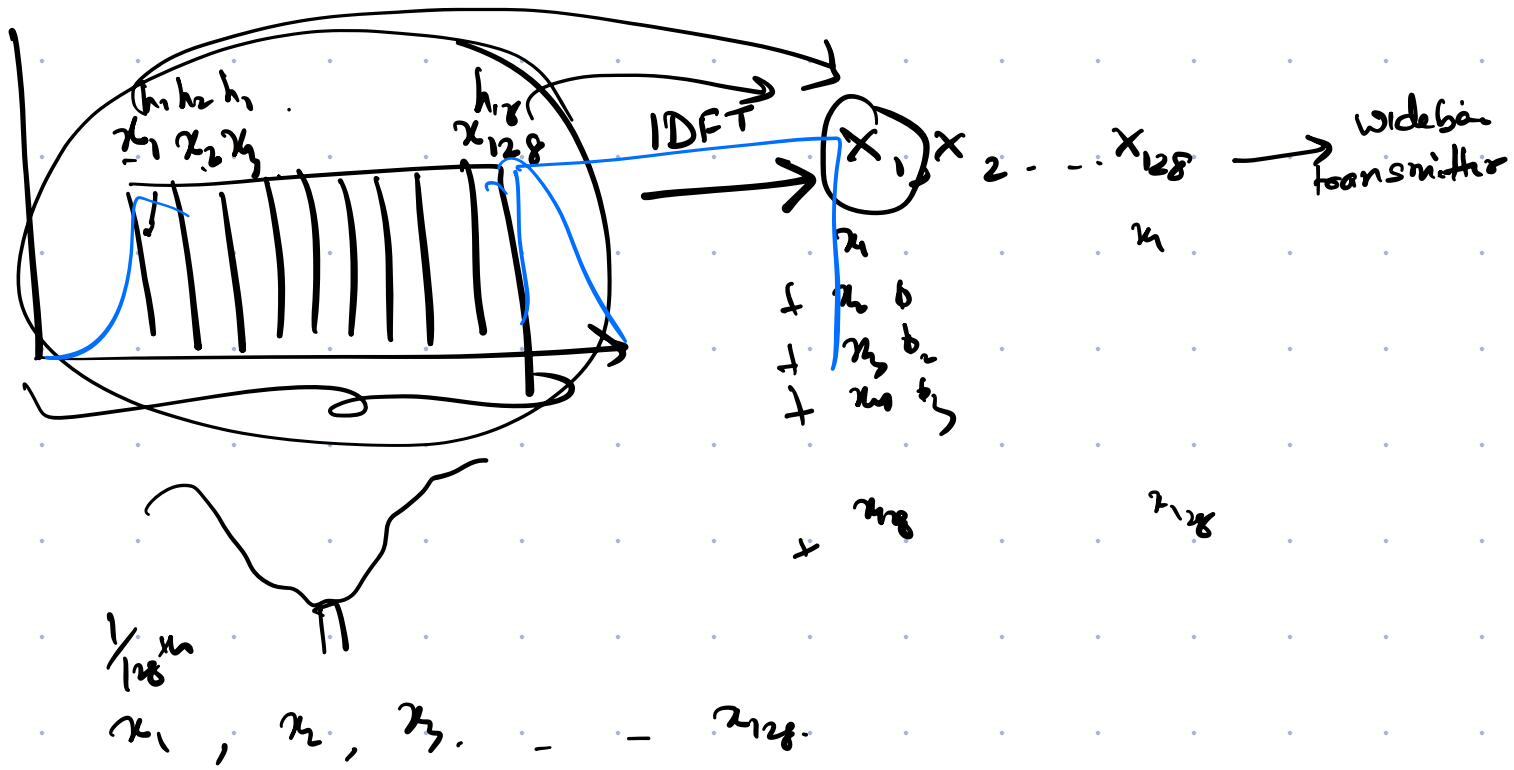
OFDM: How Do You Do It?



$$X_f = \sum_{n=0}^{N-1} x_n \, e^{-j \frac{2\pi f n}{N}}$$

N: time

OFDM: Orthogonal frequency domain multiplexing.

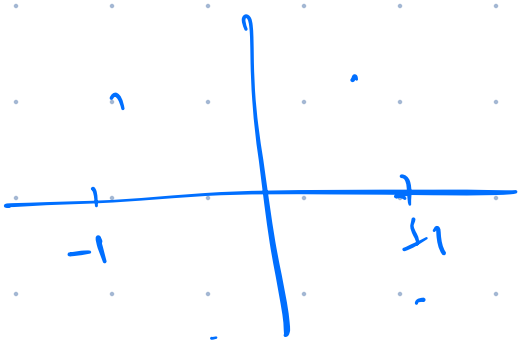


1 kHz → 1000 samples/s

↓

each symbol takes 1 ms

1 MHz → 10^6 samples/s



80 MHz, 128 ⇒ 600 kHz ⇒ $\frac{1}{600 \times 10^3}$ s

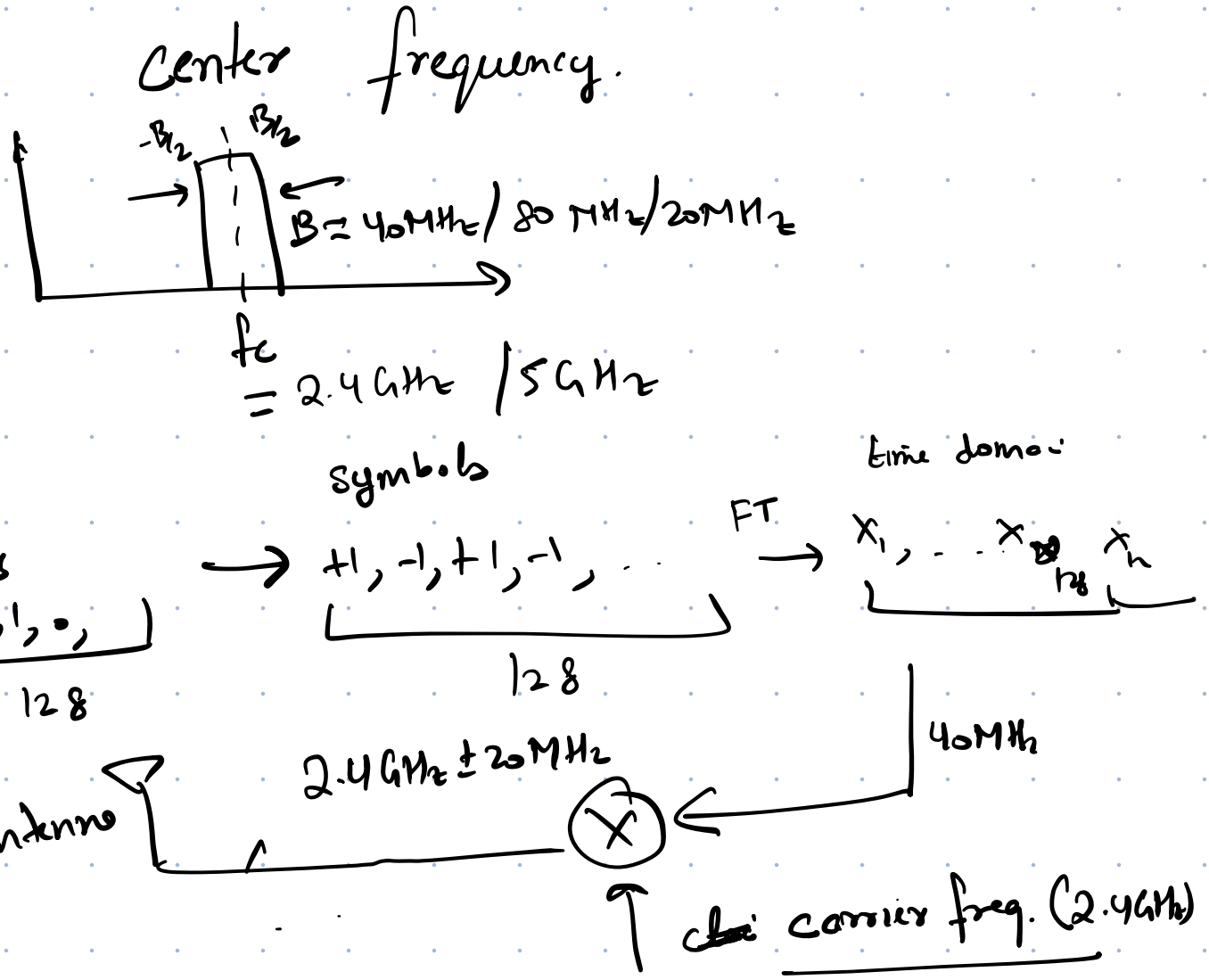
40 MHz, 128 ⇒ 300 kHz

$\frac{1}{300 \times 10^3}$ s

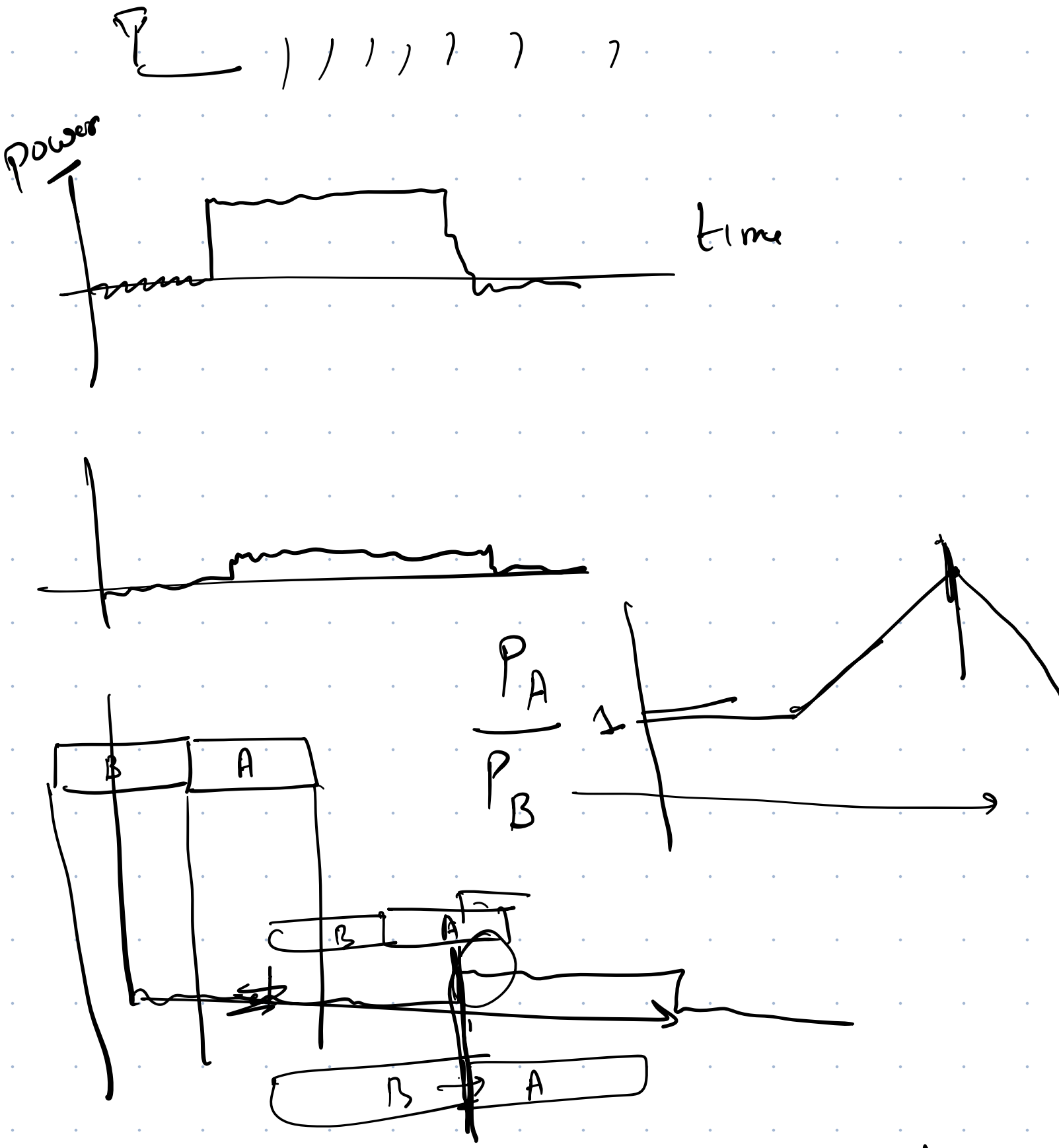
40 MHz, 256 ⇒ 150 kHz

$\frac{1}{150 \times 10^3}$ s

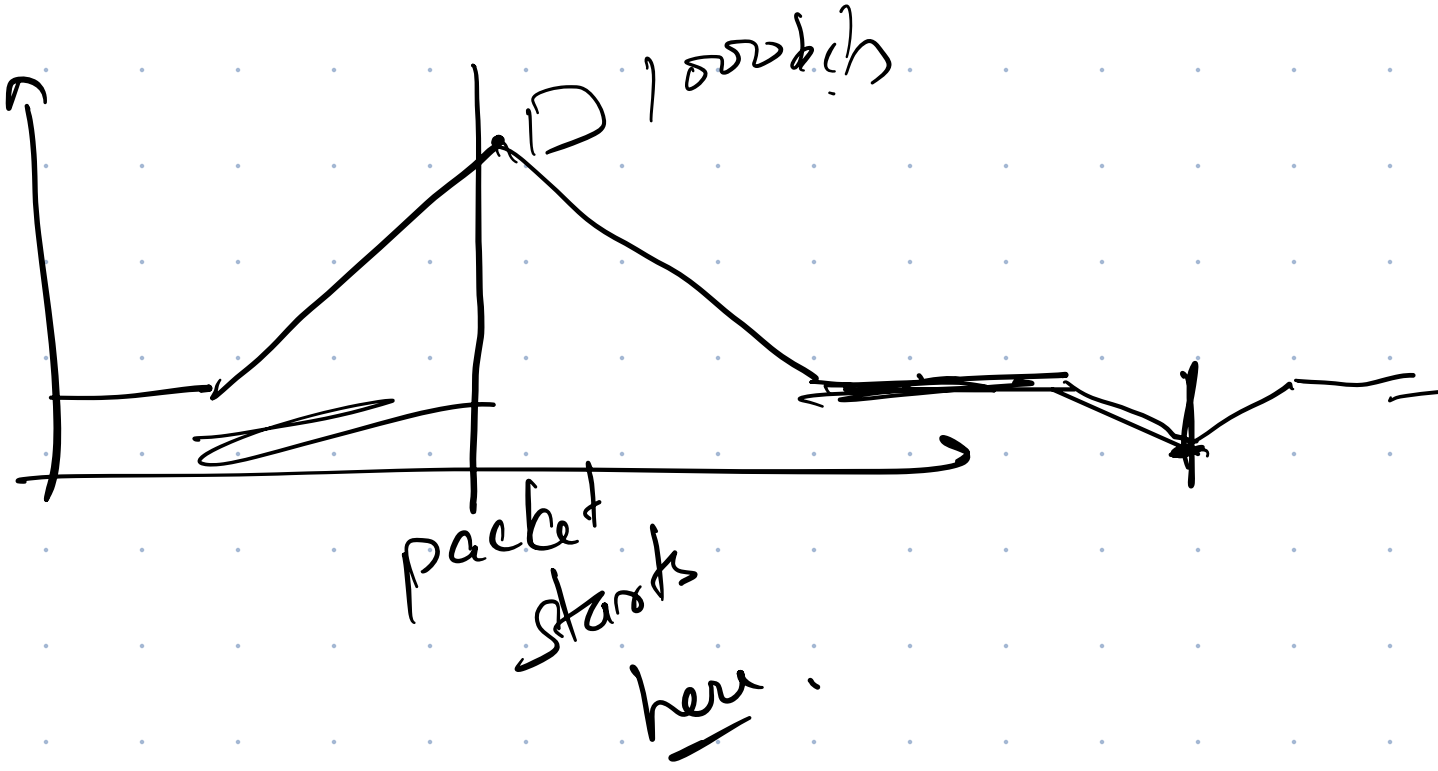
OFDM: TRANSMITTER



OFDM: PACKET DETECTION



Sliding window packet detection.


packet
starts
here.


B
A
B
A