ELEX 4340 Lecture 5 - Data Transmission over Bandlimited Channels

Exercise 1: What is the transfer function of a channel with infinite bandwidth? Does this channel meet the Nyquist no-ISI condition?

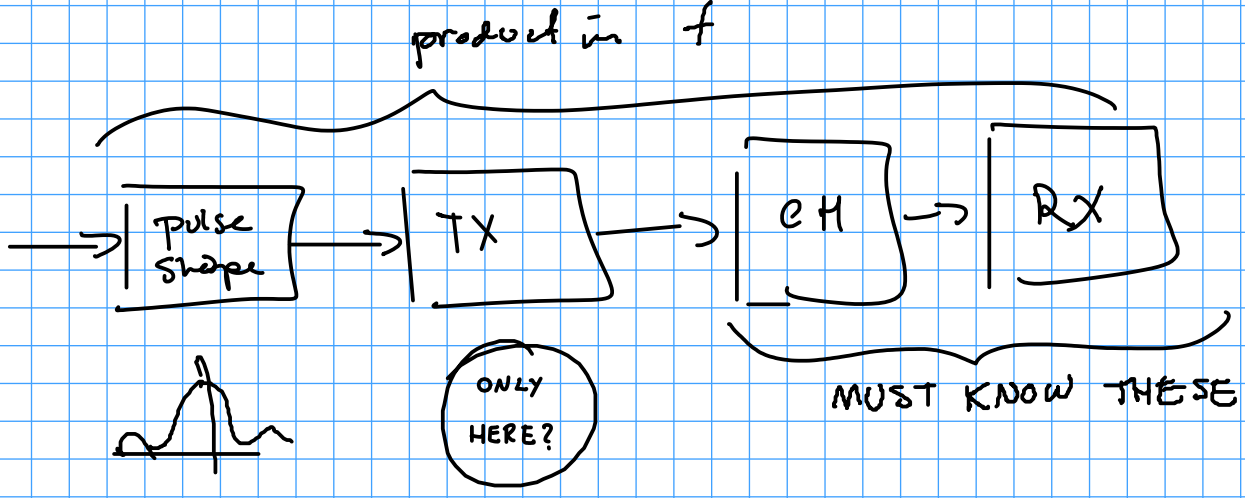
$H(f) = 1$

yes, $h(t) = 0$ for $t = T, 2T, \ldots$

Exercise 2: What is the possible range of values of α?

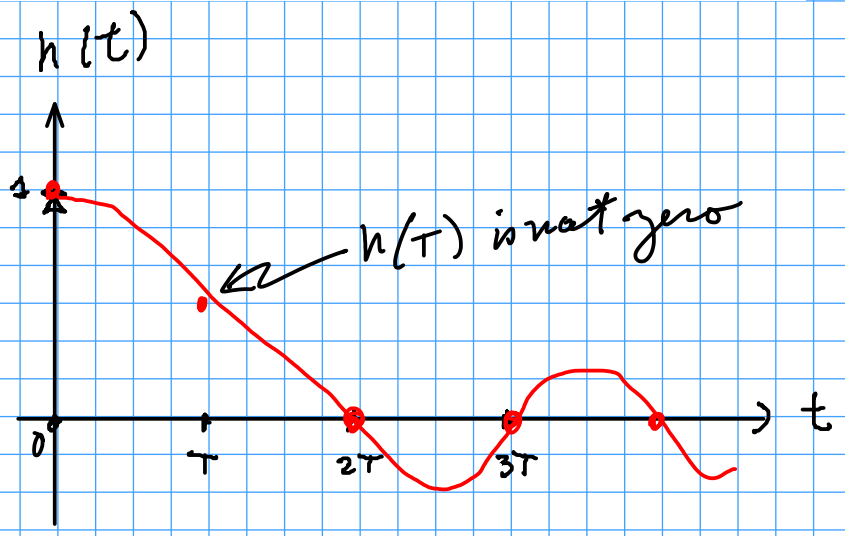
$\alpha \in (0, 1)$ (all values between 0 and 1)

Exercise 3: Could equalization be done at the transmitter only? Why or why not?



yes, all equalization could be done at TX if:
* no RX filter required for other reasons
* we know CHANNEL $H(f)$ & RECEIVER $H(f)$

Exercise 4: Draw the impulse response of a partial-response channel. Label the time axis.



Exercise 5: How many possible transmitted waveforms could be received if a sequence of 10 symbols is transmitted, each symbol being chosen from 4 possible symbols?

4 possible symbols

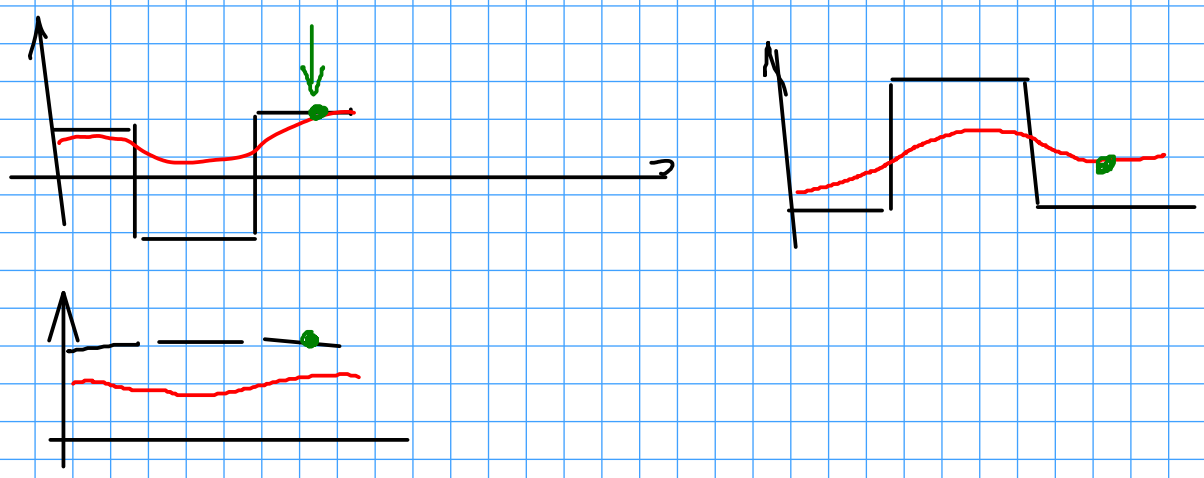
10 symbols

Q: how many possible waveforms?

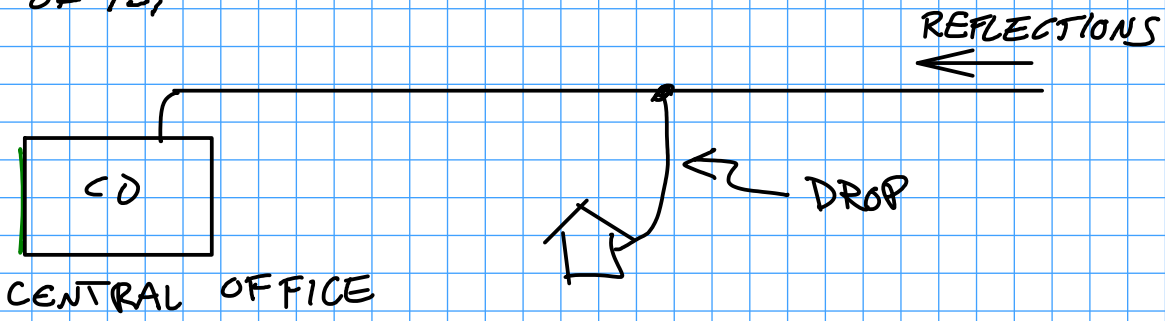
$\underbrace{4 \times 4 \times \cdots}_{10 \text{ times}} = 4^{10} = \left(2^2\right)^{10}$

$= 2^{20} \approx 10^6$

SEQUENCE ESTIMATION



ONE CAUSE OF ISI



Exercise 6: What is the channel capacity of a 3 kHz channel with an SNR of 20dB?

$$C = B \log_2\left(1 + \frac{S}{N}\right)$$

given $\begin{cases} \frac{S}{N} = 20dB \\ B = 3 \times 10^3 \text{ Hz} \end{cases}$

$$C = 3 \times 10^3 \log_2\left(1 + 100\right)$$

$$\approx 3 \times 10^3 \underbrace{6.5}_{\text{between 6 \& 7}} \approx 20 \text{ Kb/s}$$

64 128

$$P_{dB} = 10 \log\left(\frac{P_2}{P_1}\right)$$

$$20 = 10 \log\left(\frac{P_2}{P_1}\right)$$

$$2 = \log\left(\frac{P_2}{P_1}\right)$$

$$\frac{P_2}{P_1} = 10^2 = 100$$