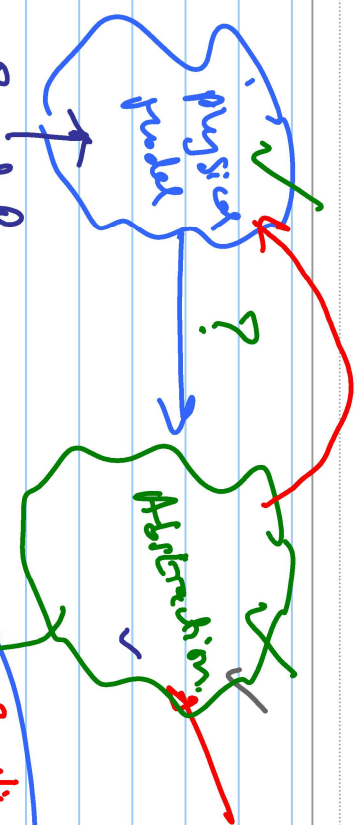


no path 3  
0  
5  
T  
↑

~~Propagation~~  
~~System~~



What is a channel?

Band Pass

Continuous Time

Guided medium  
Wireless medium  
?

Transmission Line

Multiscale Propagation

Loss / non-LOS

"Spatially local"

Noisy

Interference

mildly "non-linear"

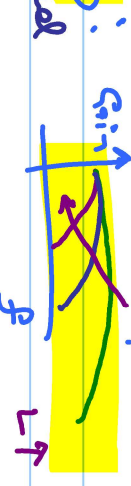
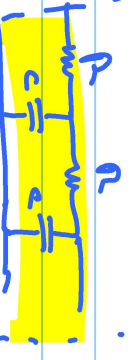
Time variant (fading)

Discrete-time

Sampling rate

Multitap channel

optical cables



effective channel

SLB

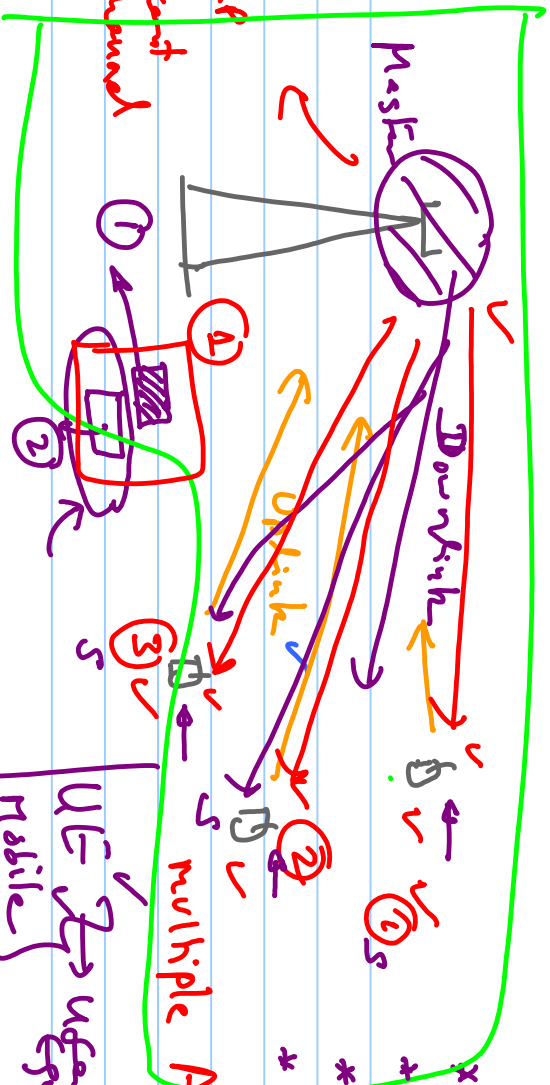
h1G

0x

A/D

T (uTs)

# Uplink



- \* time slots
  - \* freq. band
  - \* code
  - \* "spatial" signature
- DS-SSMA (Answer)

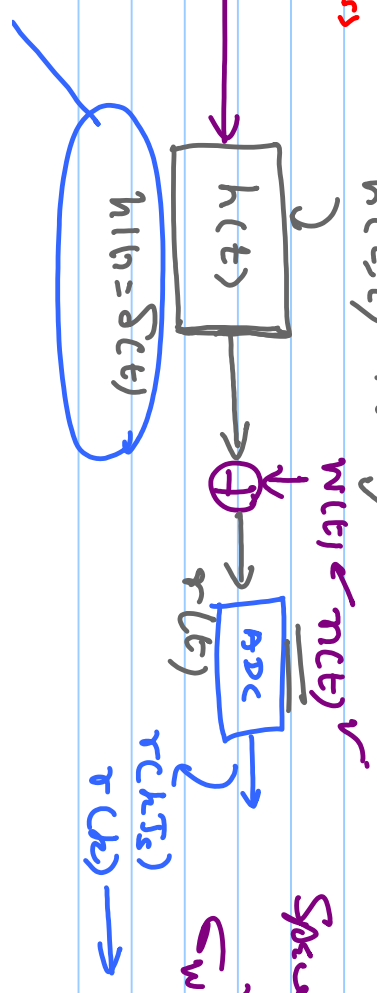
UE → User Equipment

Mobile

customer premises equipment

band-pass

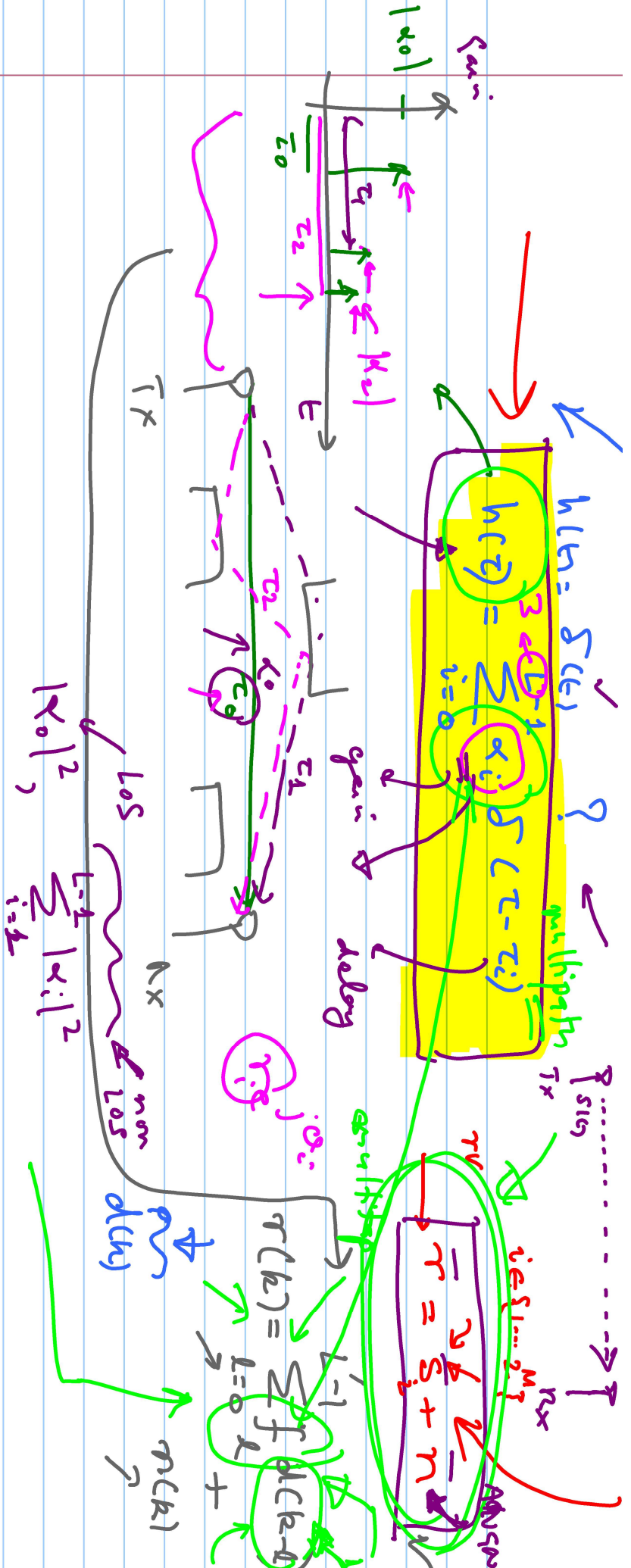
Low-pass



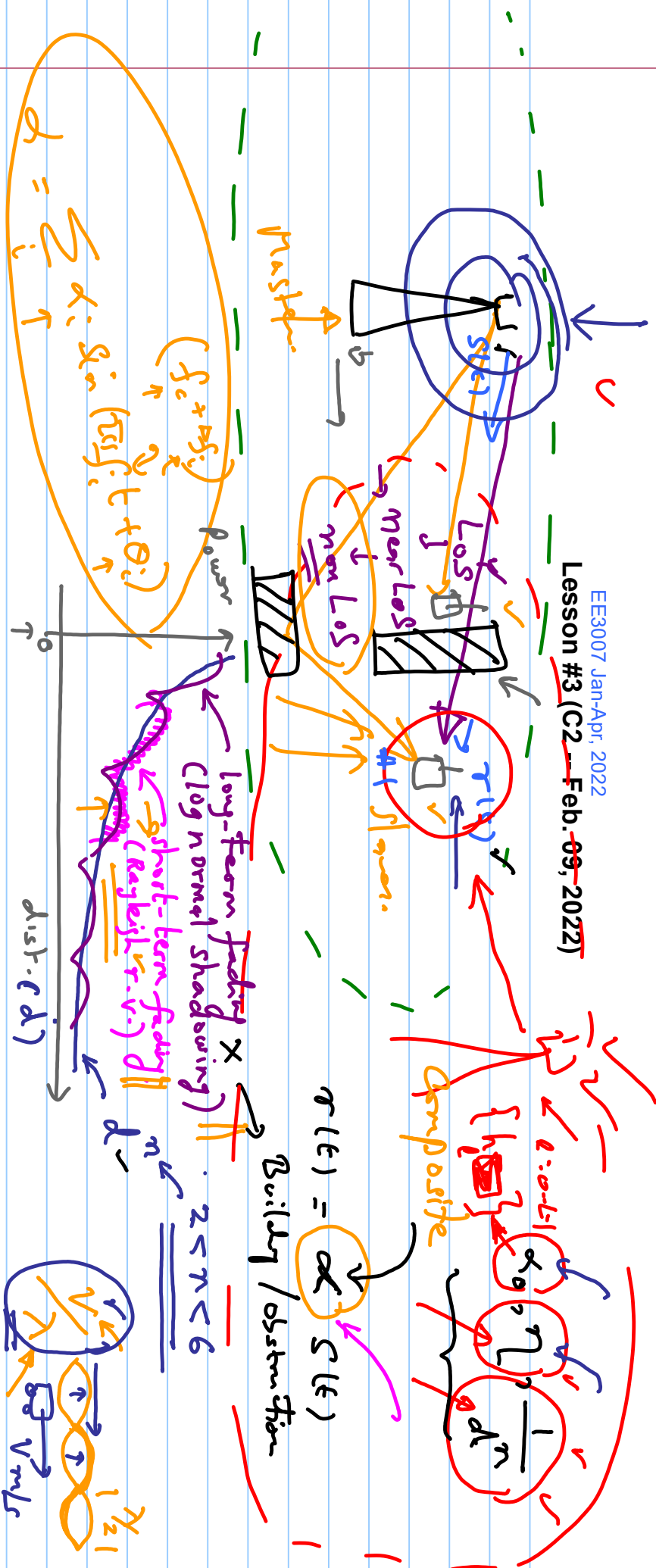
Space → star link

$$\sigma_w^2 = \sigma_s^2$$

$$\text{Avg} r(t) = S(t) + n(t)$$

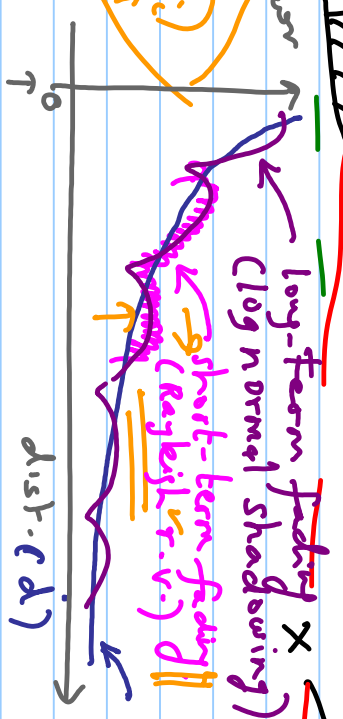


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$$d = \sum_i d_i \left( \sin(\theta_i) + \theta_i \right)$$

$(f_c + \Delta f_i)$   
 $(f_c + \Delta f_i)$   
 $(f_c + \Delta f_i)$



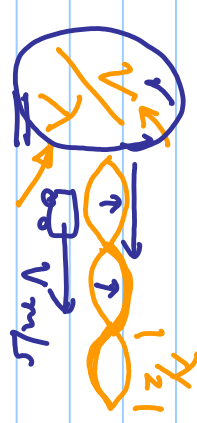
Building/obstruction

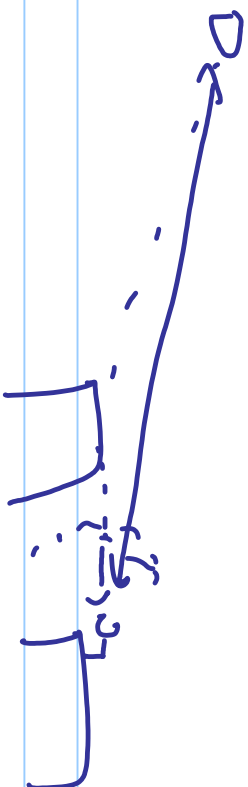
$$r(t) = \alpha S(t)$$

$$2 < r < 6$$

composite

$$\alpha_0 + \sum_{i=1}^{n-1} \alpha_i e^{-\beta_i d} + \frac{1}{d^\alpha}$$



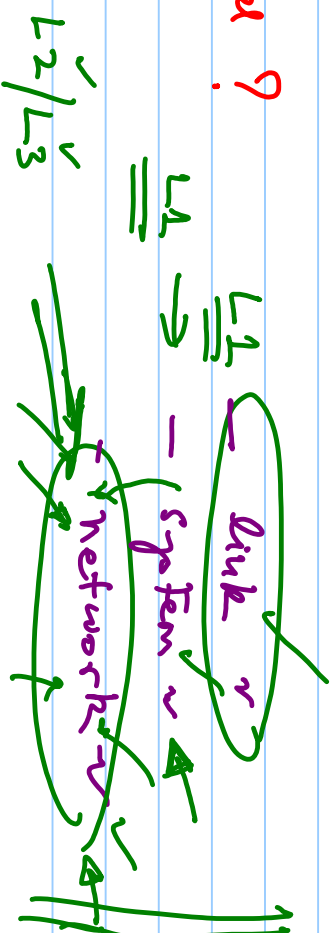
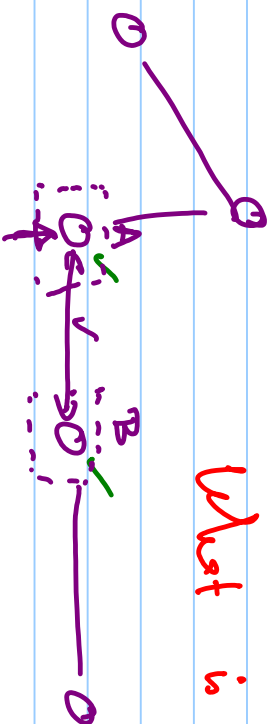


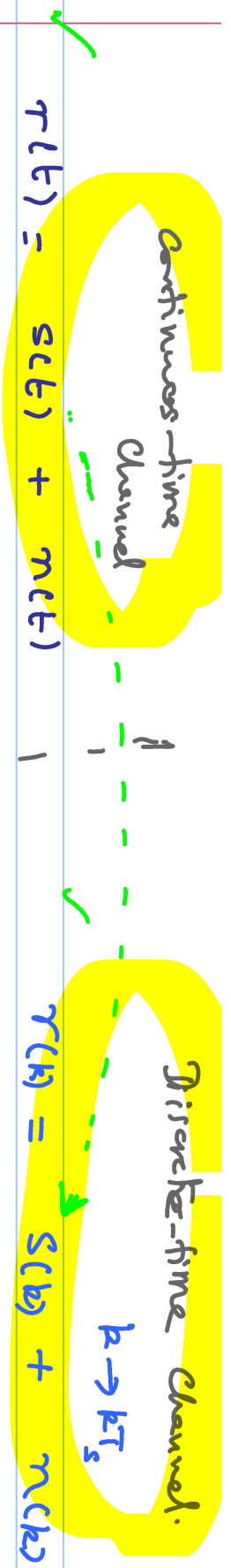
→ Running example → LOS link  
 |  
 U link

EE3007 Jan-Apr, 2022

Lesson #3 (C3 -- Feb. 11, 2022)

What is a demand?





AWGN model  
SISO  $\alpha \rightarrow \alpha(k)$

Fading SISO  $\alpha \rightarrow \alpha(k)$

$$r(k) = s(k) + n(k)$$

- $r = s + n$
- $r = \alpha s + n$

$$\sum_{i=0}^{L-1} \alpha_i s(k-L_i) + n$$

ISI channel model  $\rightarrow$  ISI channel model

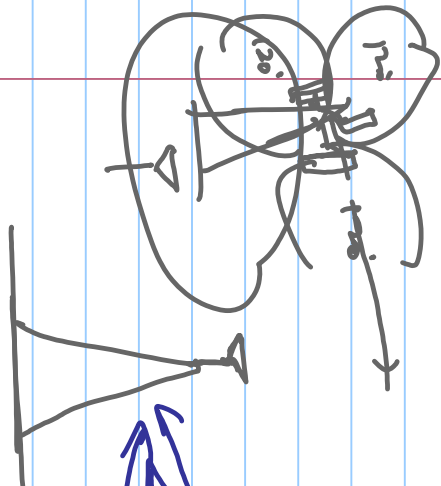
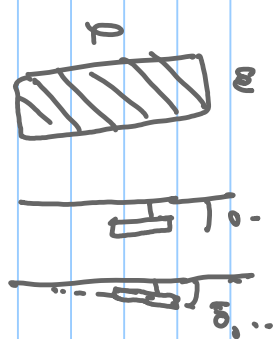
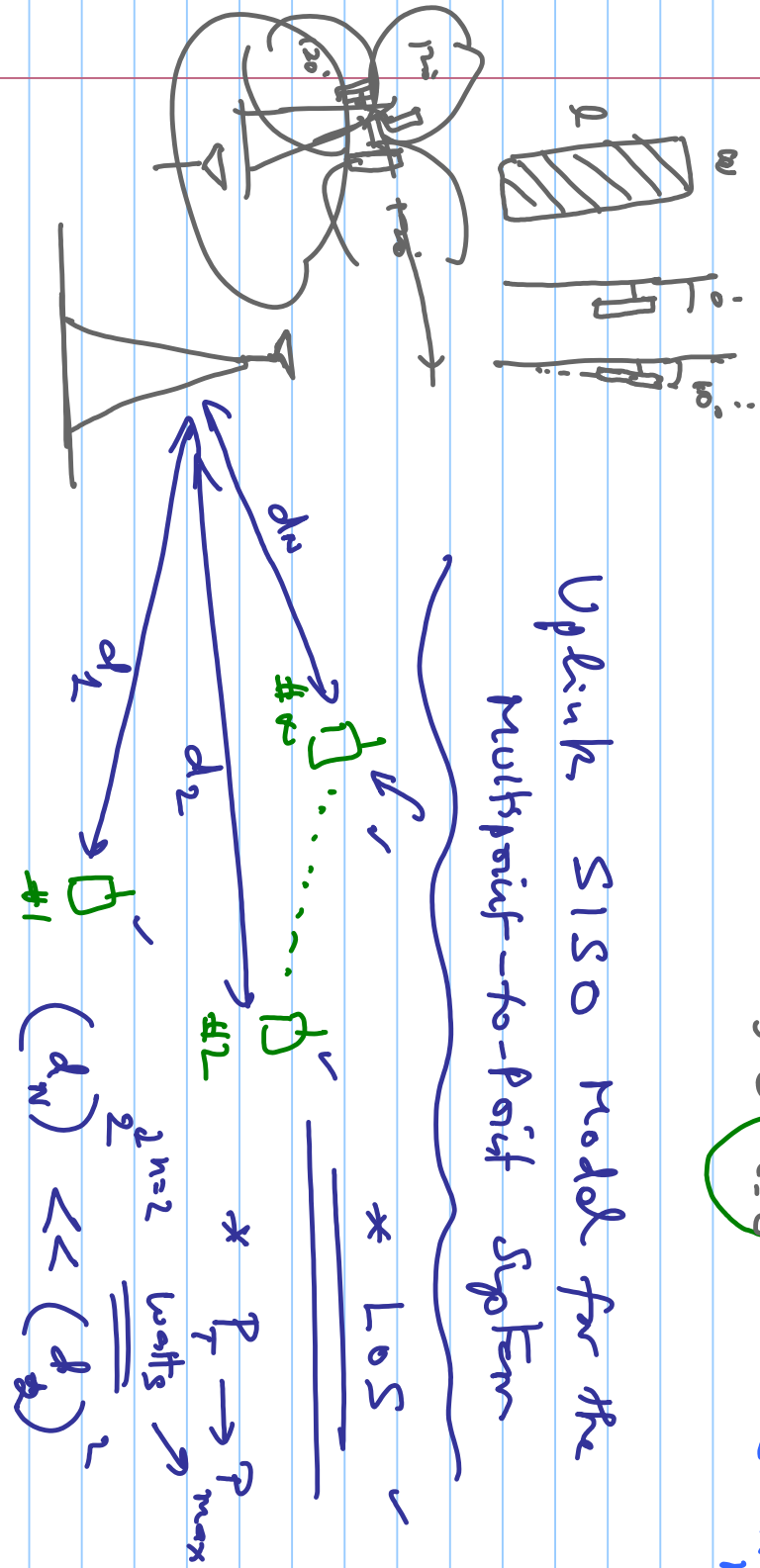
Delay-spread SISO model  $\rightarrow$  ISI channel model

ISI channel model  $\rightarrow$  ISI channel model

- $$\gamma = \sum_{j=0}^{J-1} \left( \sum_{i=0}^{L_j-1} \alpha_{i,j} S_i(r-i) + n(r) \right)$$

$\alpha_{i,j}$   $\leftarrow$  Interference Model.

Uplink SISO Model for the Multipoint-to-Point System



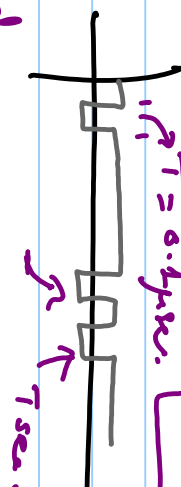
Example: TDMA System;  $BW = 10 \text{ MHz}$ .  $g(f) \Rightarrow G(f)$  ✓

Assuming symbol-duration of  $T_{\text{sec}}$ ,

$$\frac{1}{10 \text{ MHz}} = 100 \text{ nsec} = \boxed{0.1 \text{ } \mu\text{sec}}$$

↓  
1-subcarriers

$$BW \approx \frac{1}{T} = \frac{1}{0.1 \text{ } \mu\text{sec}}$$



TDMA/TDMA ✓

\*  $N = 10$  users are to be served

