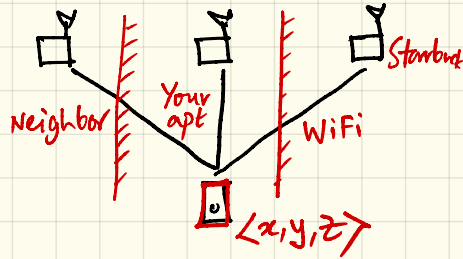
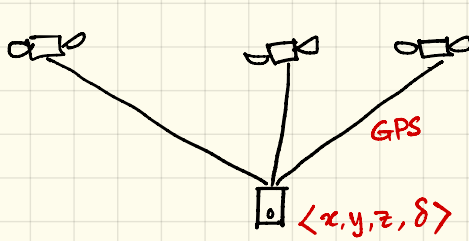


WiFi based Indoor Localization



① GPS signals do not penetrate into buildings

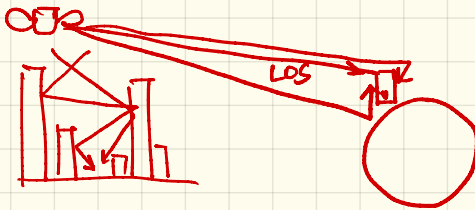
② How about bringing GPS like trilateration to WiFi?
 ↳ Any challenges / problems?

GPS

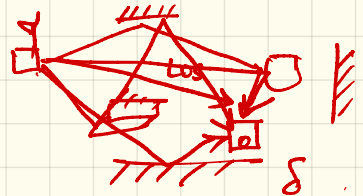
Vs.

WiFi

- mostly line of sight (LOS) with few echoes or multipath



- Heavy echo or multipath in indoor env.



- GPS satellites are clk syn.
- GPS satellite locations are known.

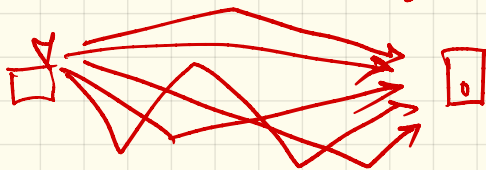
- WiFi Access points / BS / routers are not clk sync. across diff owners.
- WiFi AP locations are unknown.

⑤ Key idea : 1999 WiFi standard \rightarrow IEEE 802.11

WiFi RADAR \rightarrow localize laptops or PDA in indoor environments.

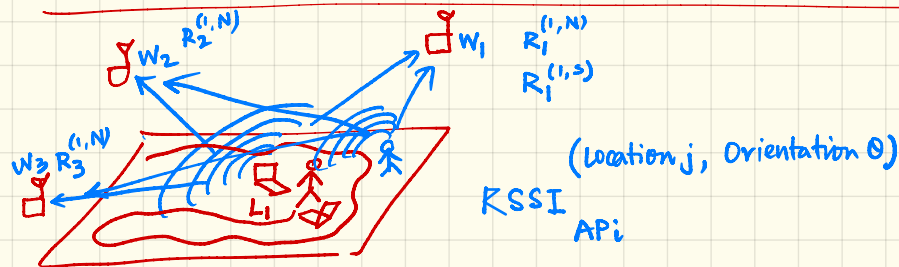
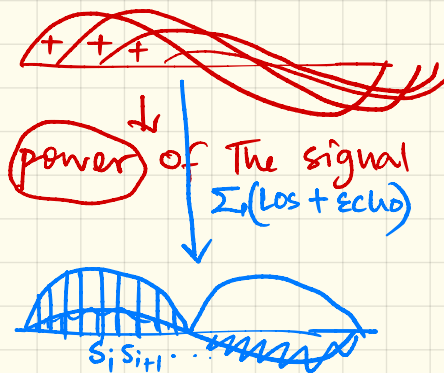
\hookrightarrow RSSI Fingerprinting.

Received Signal Strength Index



$$\text{Power} = \frac{1}{K} \sum_{i=1}^K |S_i|^2$$

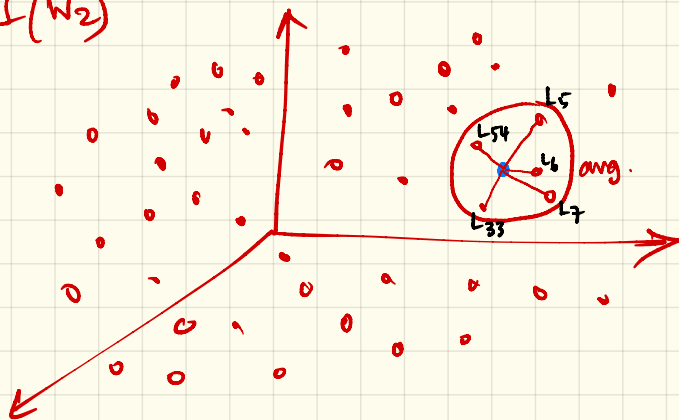
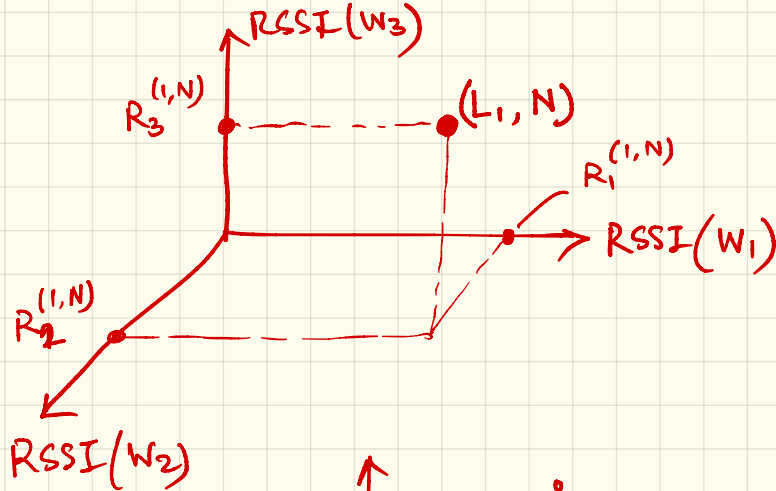
$$\text{Energy} = \sum_{i=1}^K |S_i|^2$$



Calibration
Fingerprints
Wave driving
Training.

$P_1, P_2, P_3 \rightarrow L, \theta ?$

Loc	Ori.	RSSI(W1)	RSSI(W2)	RSSI(W3)
L1	N	$R_1(1, N) =$	-	-
L1	S	$R_1(1, S) =$		
L1	E	$R_1(1, E) =$		
L1	W	$R_1(1, W) =$		
L2				
L2				
L2				
...				
L500	1			

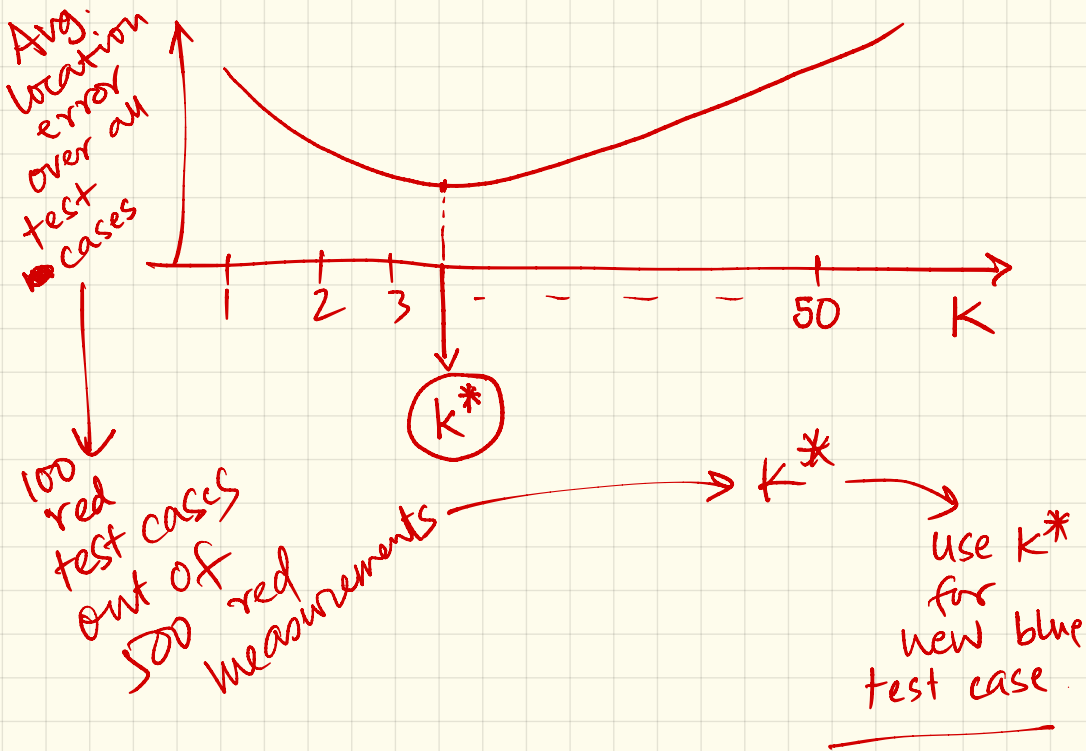


$K=5$

① Nearest neighbor : Pick nearest labeled point & declare the label as the blue user's location

② K-Nearest neighbors and compute avg.

Can you find a scenario in which K-NN performs worse than NN.



Wifi localization \rightarrow 2m — 10m

