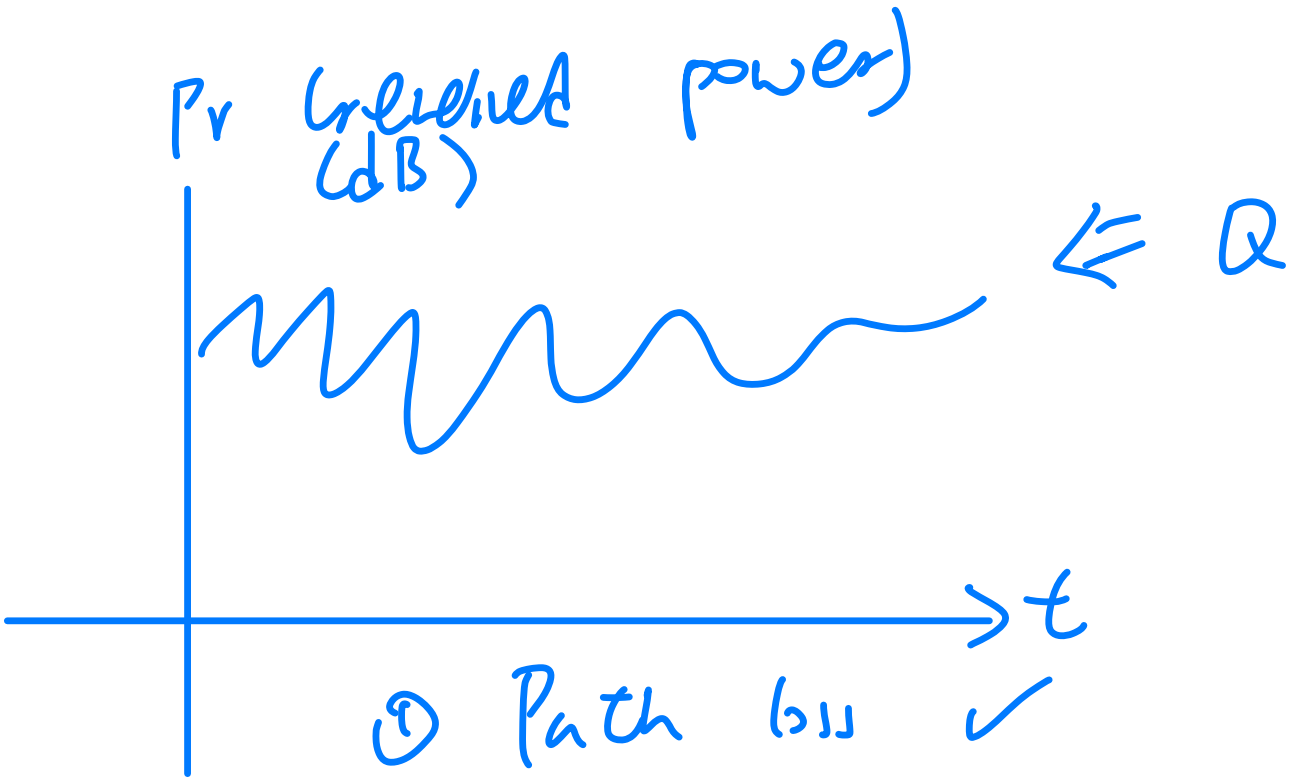
Mobile communication system

Point to point communication

channel not only AWGN, but also other things, especially fading!



Path loss: $P_r \propto \frac{1}{d^\alpha}$

Energy get diluted in large and large surface!

path loss exponent

$\alpha = 2-4$,

or even more drop even faster!

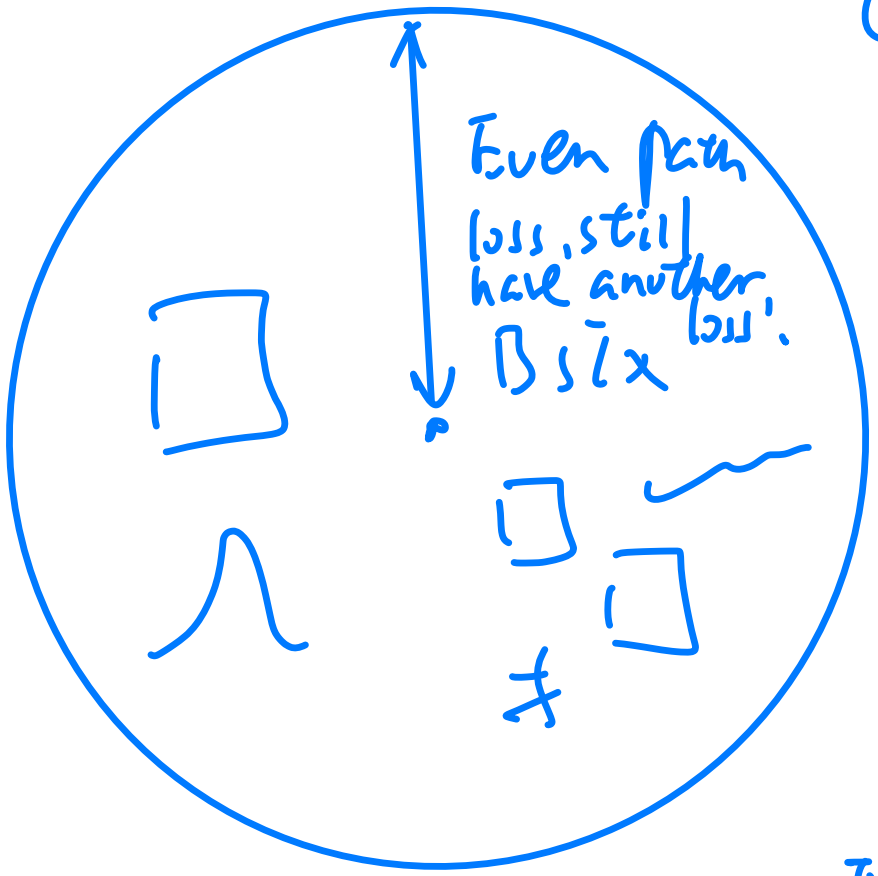
① Path loss ✓

(a) timescale: slow process

(b) dynamic range: 140 dB

huge contrast!

- Link budget analysis.

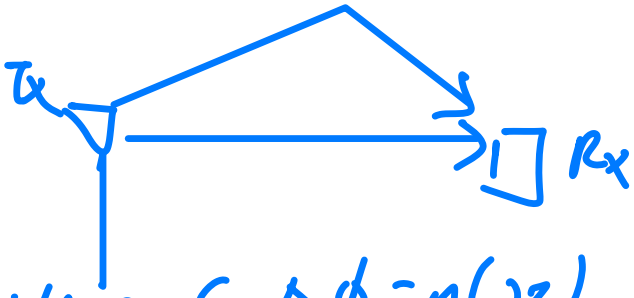


② Shadowing

(a) timescale: slow

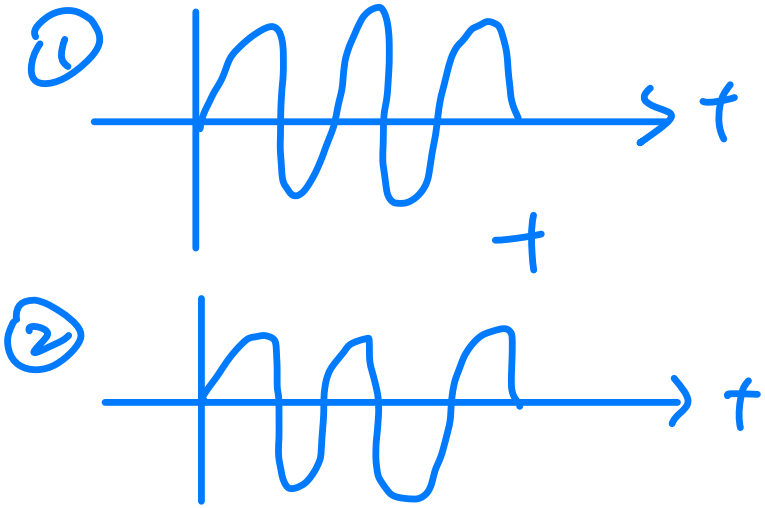
(b) dynamic range!
8-18 dB

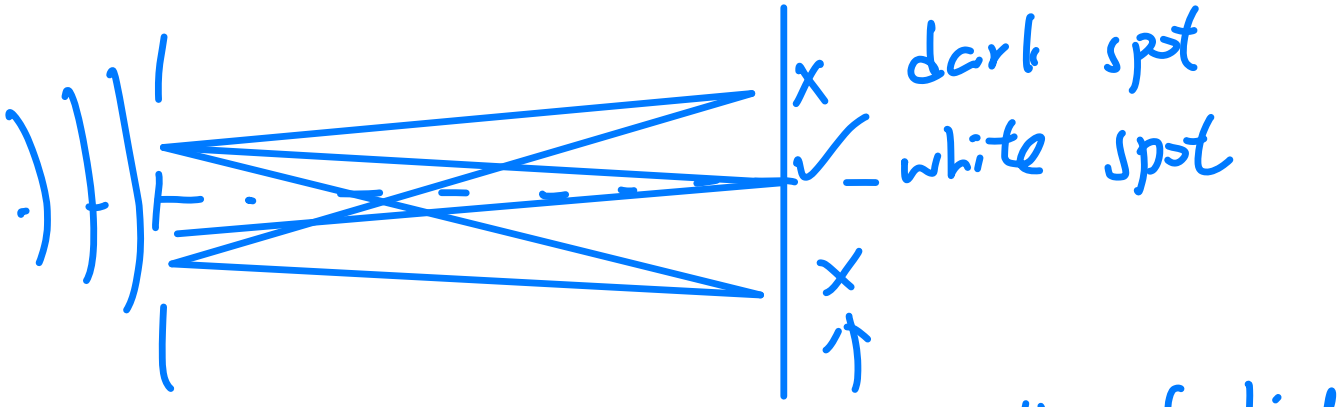
③ microscopic fading (multipath)



constructive superposition $\begin{cases} \Delta\phi = n(2\pi) \\ \Delta l = n\lambda \end{cases}$

destructive superposition $\begin{cases} \Delta\phi = (2n+1)\pi \\ \Delta l = (n+0.5)\lambda \end{cases}$





destructive fading

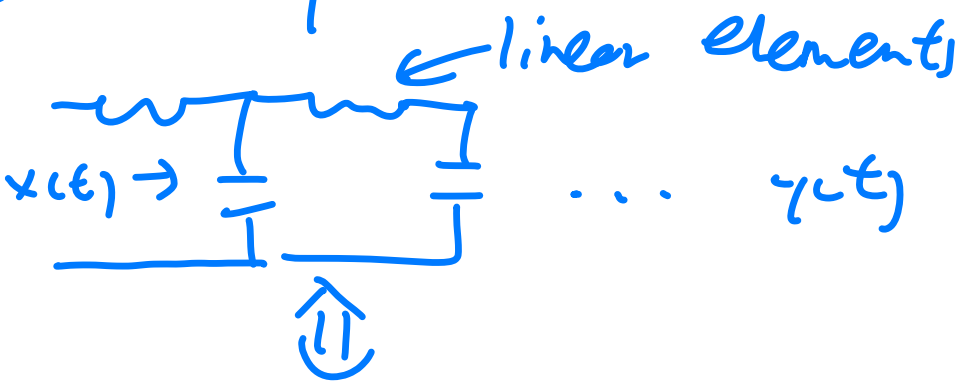
③ Microscopic fading (multipath)

(a) time scale: fast (ms)

(b) dynamic range!
~Rayleigh distribution ~40dB

- Much focus on this!

① Limit theory



② EM theory

Maxwell equations operators are linear

E-field for voltage

B-field for current

③ System theory for arbitry input