Q: Will a Microwave kill your WiFi speeds?

→ Review Keysight MicrowaveDemo/Analysis

→ short answer: yes it does.

due to noise / interference from microwave!

results in reduced SNR (because signal power is the same, but noise power increased)

which results in lower WiFi speeds

back to lecture 14 slides. (Matched Filtering)

(slide 14-15)

⇒ if you know the pulse shape of the Txed signal, you have the matched filter impulse response

Matched Filter: $h_{opt} = k\, g^*(T - t)$

* T = symbol time
  you can delay any amount of symbol times T
  (ie. T, 2T, 3T all okay to get best/optimal)
* gain k = should NOT be 0

⇒ goal: have Matched Filter (MF) and PulseShaping filter @ Txer be the same!!

MF ⇒ essentially just correlating Rxed signal with pulse shape g

correlation = convolution without flip!

→ = flip & slide

→ only slide

thus, we can implement MF using convolution of flipped pulse shape!

⇒ which is just correlation!

Student Q: where does $\frac{2}{N_0}$ come from in SNR @ slide 14-15?

answer: refer back to slide 14-9

$$SNR = \frac{\text{instantaneous power}}{\text{avg Noise power}}$$

$$\text{avg. noise power} = \sigma^2 = N_0/2$$

$$\text{and } \frac{1}{\text{avg Noise power}} = \frac{1}{(N_0/2)} = \frac{2}{N_0}.$$

thus, we get the $\frac{2}{N_0}$ in SNR in slide 14-15.

now consider example of MF for Rectangular Pulse shape. (slide 14-16)

if Txed Pulse Shape = $g$ = Rectangular,
what is Matched Filter? ⇒ SAME pulse shape as $g$! Rectangular!

(examine slide 14-17) ⇒ Block Diagram of Tx / Rx System for Matched Filtering

MF impulse response:

continuous time: $h_{opt}(t) = k \cdot g^*(T_{symb} - t)$

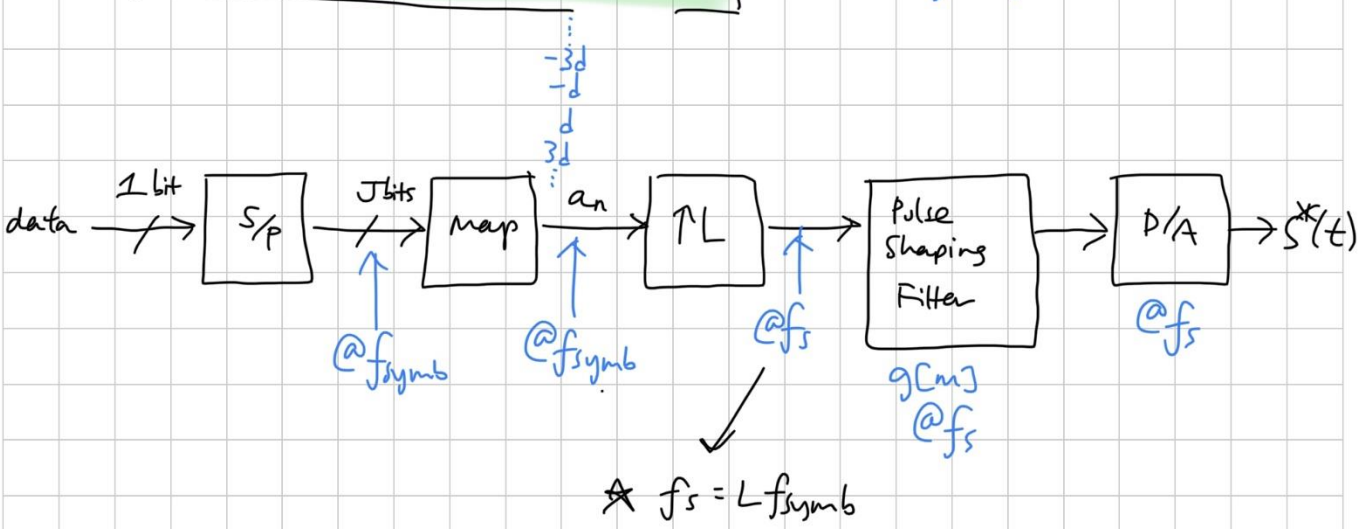
- $k$: scale/gain
- $T_{symb}$: delay
- $-t$: flip in time
- $^*$: conjugate

* any multiple of delay $T_{symb}$ is ok!

discrete time: $h_{opt}[m] = k \cdot g^*[L - m]$

* any multiple of delay $L$ is ok!

## Block Diagram of Baseband Tx (4PAM system)




$\star\ f_s = L f_{symb}$

map = constellation mapping (for 4PAM example)

| Symbol of Jbits: | Symbol amplitude $a_n$: |
|---|---|
| 01 | +3d |
| 00 | +d |
| 11 | -d |
| 10 | -3d |

NO grey-coding (bad)

Q: why delay @ Tsymb (or L in discrete time)? (why sample with delay of Tsymb/L)

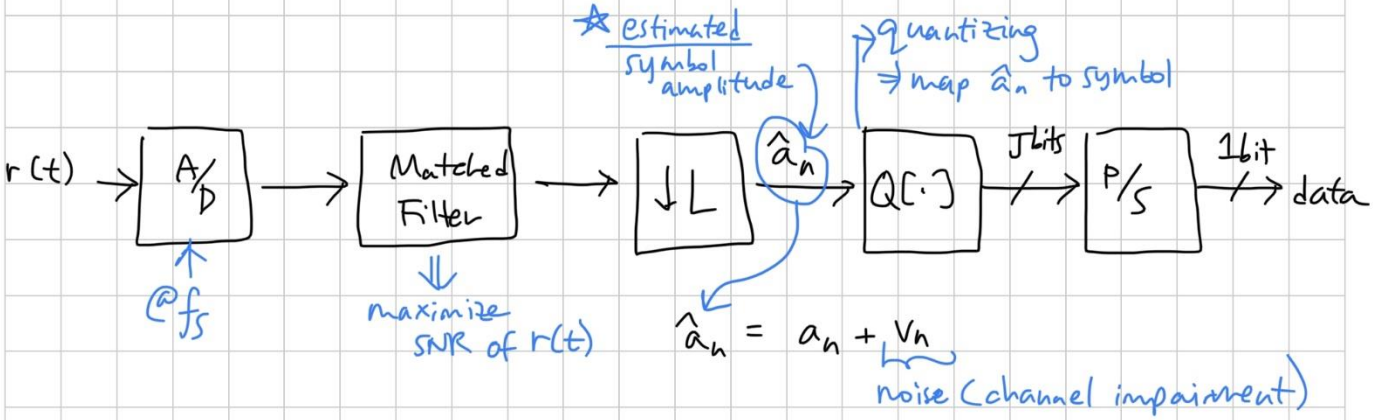
A: because we get peak (max) SNR @ delay Tsymb (or L)

(reference diagrams on slide 14-17)

(break @ 11:06 AM)

(return @ 11:11 AM)

# Block Diagram of Baseband Rx (4PAM system)

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+2d, 0, -2d: Rxer threshold between symbols

NO grey-coding (bad)

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| 10 | -d |
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+2d, 0, -2d: Rxer threshold between symbols

WITH grey-coding ★ (better!)

Grey-Coding MINIMIZE symbol error!! (good)

⇒ less chance for mistake

**how to minimize bit error rate? (@ Rxer)**

1. use Matched Filter (increase Rxed signal SNR)
2. implement Grey-Coding in Constellation Mapping (reduce chance for symbol error)

(move on to slide 14-(8)) **Bit Error Discussion for 2PAM**

consider, $r(t) \rightarrow$ [$h(t)$ Matched Filter] $\rightarrow \tilde{r}(t) \rightarrow$ (sampling) $\rightarrow r_n$

↳ what is Bandwidth (BW) of Matched Filter (MF)?

if Pulse Shape @ Txer, $g$ is Raised Cosine Pulse, then BW of MF, $h(t)$, is...

$$BW = \frac{1}{2} f_{symb} (1+\alpha)$$

Derivation of Probability of Bit Error for 2PAM
(slides 14-20 → 14-23)

What about for more general M-PAM case?
(slide 14-24