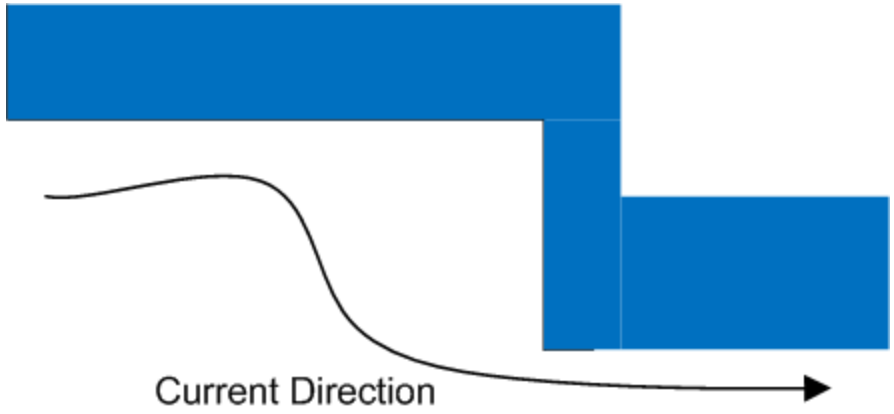
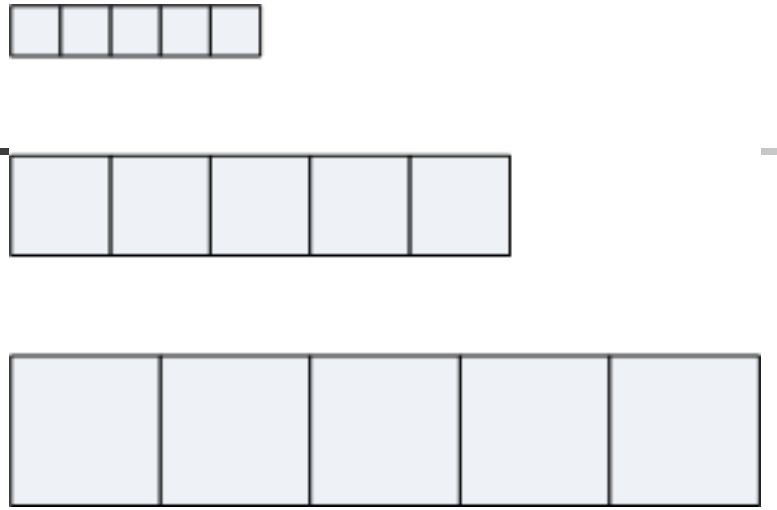
How to find delay of wire?



Given:

- A piece of wire (poly or metal)
- Current Direction
- Rs (sheet resistance in Ω/□)
- □Cg (gate to channel capacitance of a min size MOS transistor)

Rs: Sheet Resistance



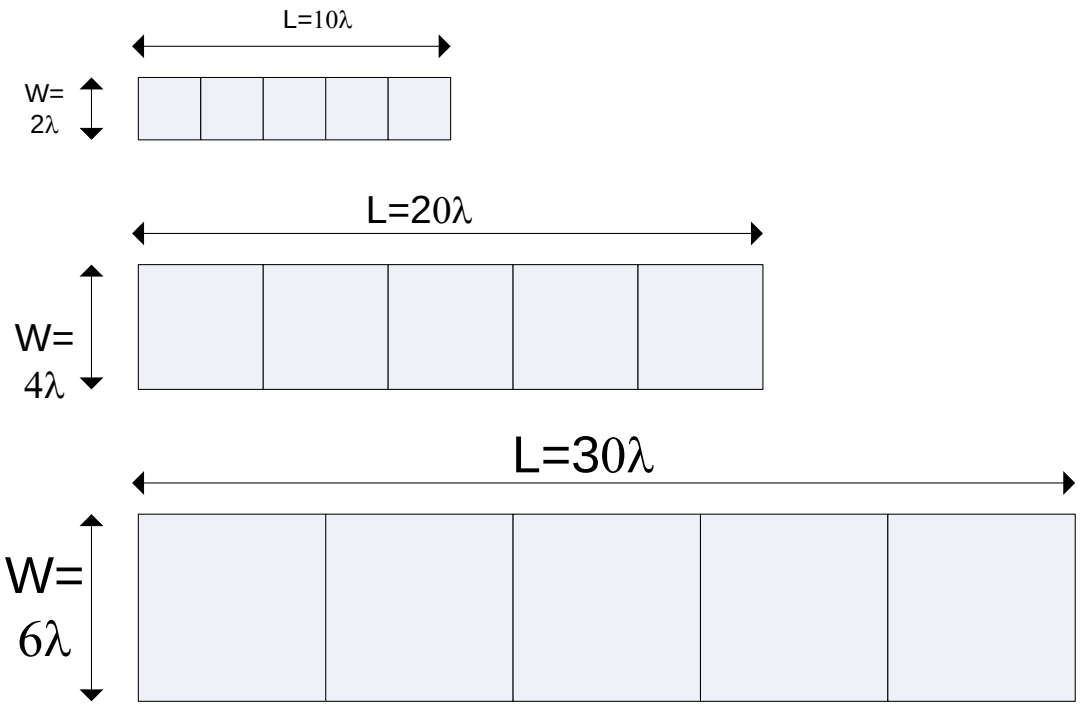
What is Ω/□ (Ω per square)?

The 3 metal pieces have 5 squares.

If Rs=2Ω/□, they all have R=5*2=10Ω

Sheet Resistance

$R = R_s * (L/W)$, $R_s = 2\Omega/\square$

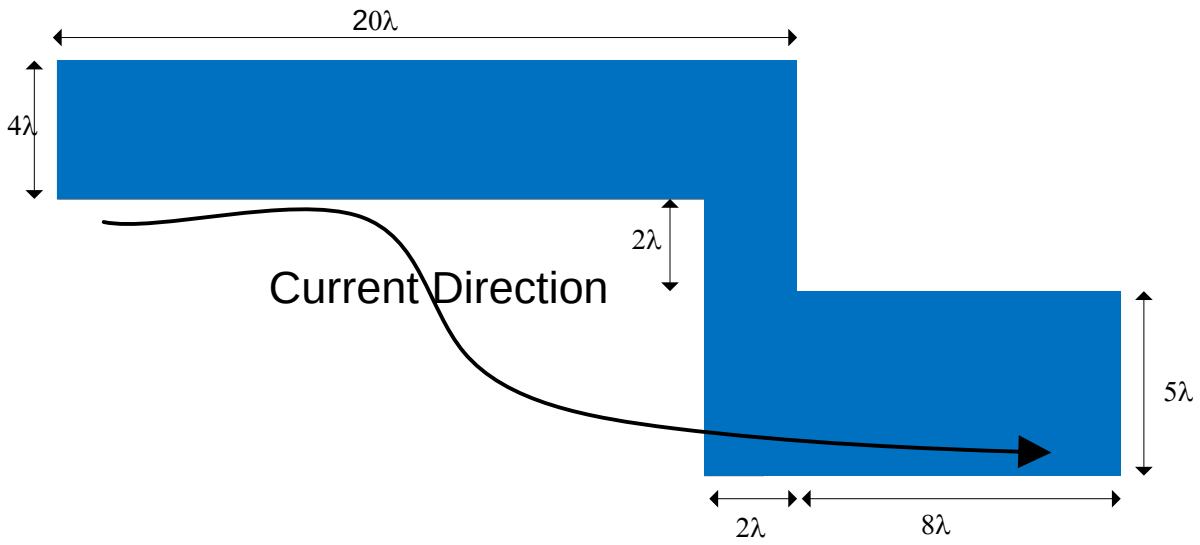


R1 = 2(10λ/2λ)=10Ω

R2 = 2(20λ/4λ)=10Ω

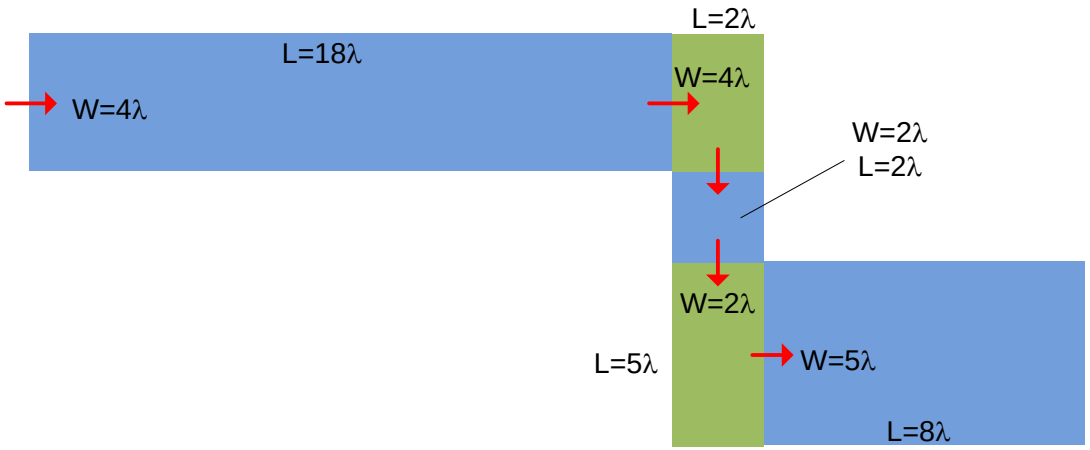
R3 = 2(30λ/6λ)=10Ω

Beware of Corners



- Divide the wire into pieces for calculation.
- Identify the corner pieces

Beware of Corner



- The length and width are decided at the point when current enter the piece
- Corner only contributes ½ of its resistance
- R = Rs*[(18/4) + ½ (2/4) + (2/2) + ½ (5/2) +(8/5)]
  = 2*8.6=17.2Ω

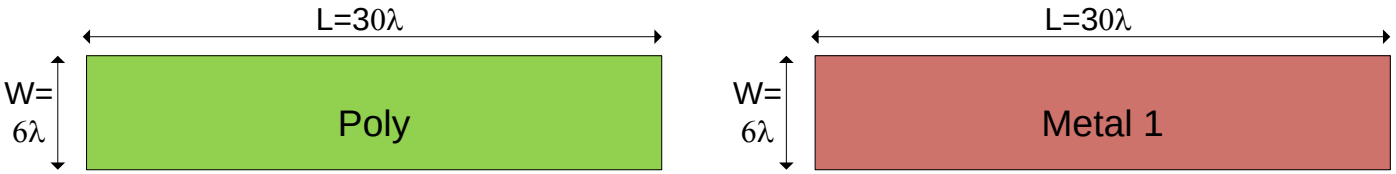
□Cg

□Cg = gate to channel capacitance of a min size (2λ*2λ) MOS transistor

- C = Relative Area * Relative Cap * □Cg
- Relative Area, since wrt min size of 2λ*2λ
- Relative Cap, since wrt poly layer

Material	Capacitance (aF / μm^2)	Relative Capacitance
Gate to channel	100	1.00
Diffusion to substrate	40	0.40
Polysilicon to substrate	100	1.00
Metal1 to substrate	30	0.30
Metal1 to polysilicon	65	0.65
Metal2 to substrate	15	0.15
Metal2 to polysilicon	18	0.18
Metal2 to Metal1	35	0.35

Example (same area but different layer)

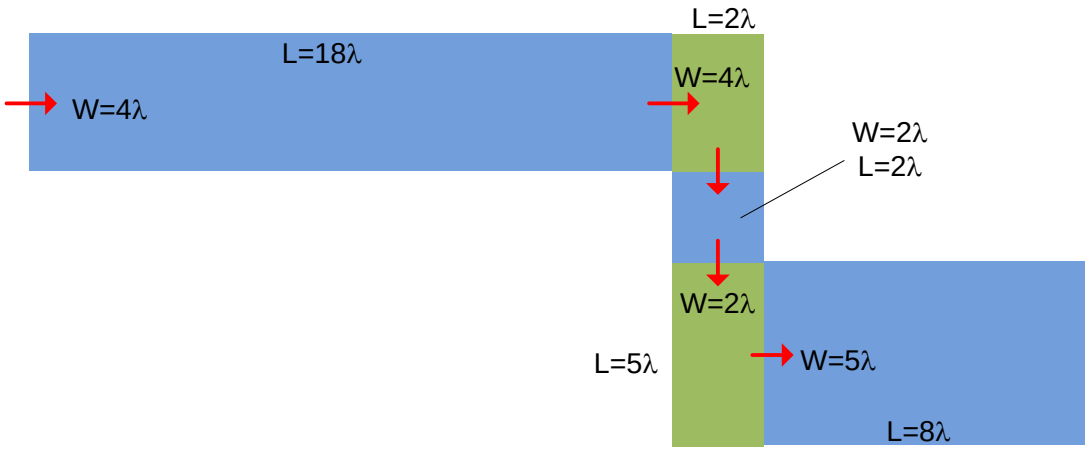


Poly:
Relative Area = (30*6)/(2*2)=45
Relative Cap = 1
C = 45*1* □Cg

Metal1:
Relative Area = (30*6)/(2*2)=45
Relative Cap = 0.65
C = 45*0.65* □Cg

Note:
Relative Area = Area / min_size
Relative Cap table will be given. Don't need to remember

Example



- Assume the wire is Metal 1
- C = (18*4+2*4+2*2+5*2+8*5)/(2*2) *0.65*□Cg
  = 21.78 □Cg
- Delay = RC = 17.2 * 21.78 □Cg = 375 □Cg