VLSI Design - Lecture 10

29th Aug 2022

$$t_p = N t_{p0}\left(1 + f/\gamma\right) \qquad C_j = \sqrt{C_{j-1} C_{j+1}}$$

Both can be designed.

$$F = \frac{C_L}{C_{in}} = f^N \qquad N = \frac{\ln F}{\ln f}$$

$$t_p = \ln F\, t_{p0}\left(\frac{1}{\ln f} + \frac{f}{\gamma \ln f}\right)$$

$$\frac{dt_p}{df} = 0 \text{ for } f_{opt}$$

$$\frac{-1}{(\ln f)^2}\cdot\frac{1}{f} - \frac{f}{\gamma}\cdot\frac{1}{(\ln f)^2}\cdot\frac{1}{f} + \frac{1}{\gamma \ln f} = 0$$

$$\frac{1}{\gamma} = \frac{1}{\ln f}\left(\frac{1}{f} + \frac{1}{\gamma}\cdot\right)$$

$$\ln f = 1 + \frac{\gamma}{f}$$

$\gamma = 0 \quad f = e$

$\gamma = 1 \quad f = 3.6$

Optimum f

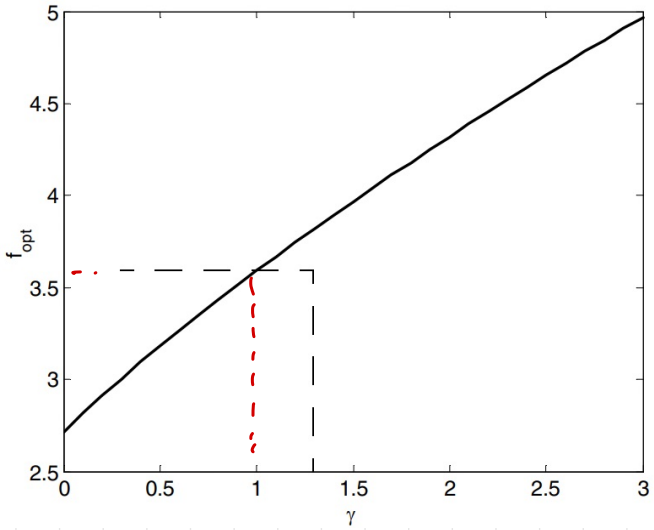
$F = 1000$

$$N = \frac{\ln F}{\ln f} = 5.4$$

$N = 5 \quad t_p = 5 t_{p0}(1 +$

$= 23 t_{p0}$

$N = 6 \quad = 27.6 t_{p0}$



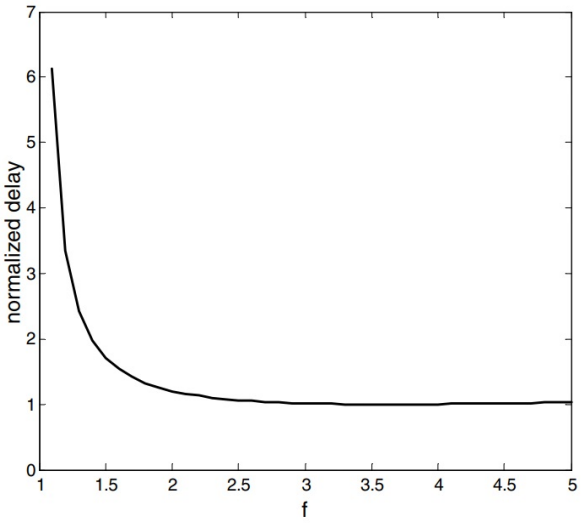
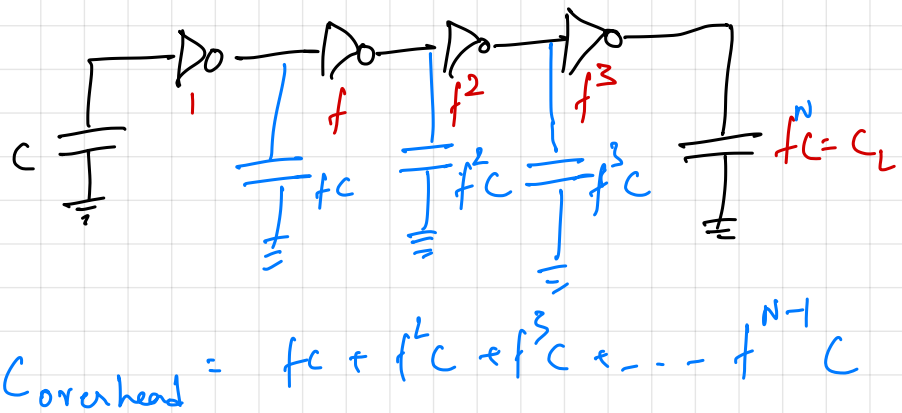


Table 5.3 t_{opt}/t_{p0} versus x for various driver configurations.

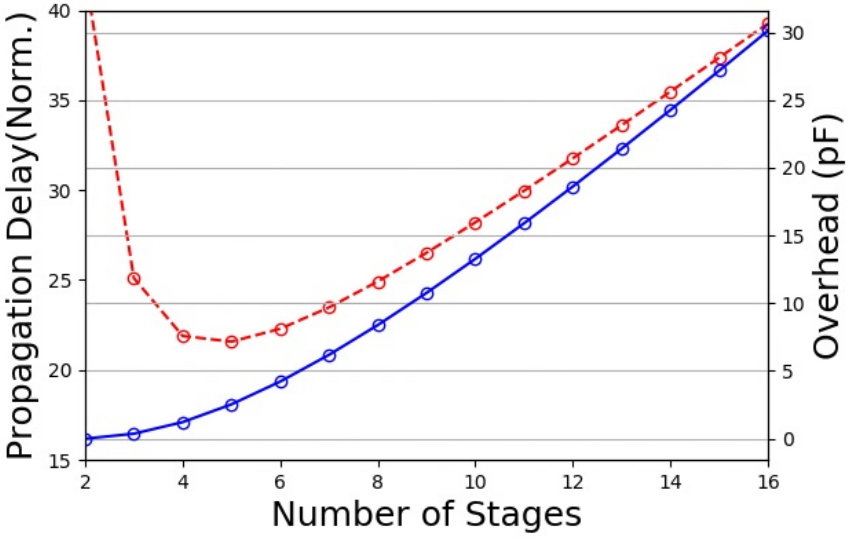
F	Unbuffered	Two Stage	Inverter Chain
10	11	8.3	8.3 2
100	101	22	16.5 3
1000	1001	65	24.8 5
10,000	10,001	202	33.1 7

$\frac{\ln(10000)}{\ln(3.6)} = 7$ $\quad f = (10000)^{1/7} = 3.7$

7×4.7

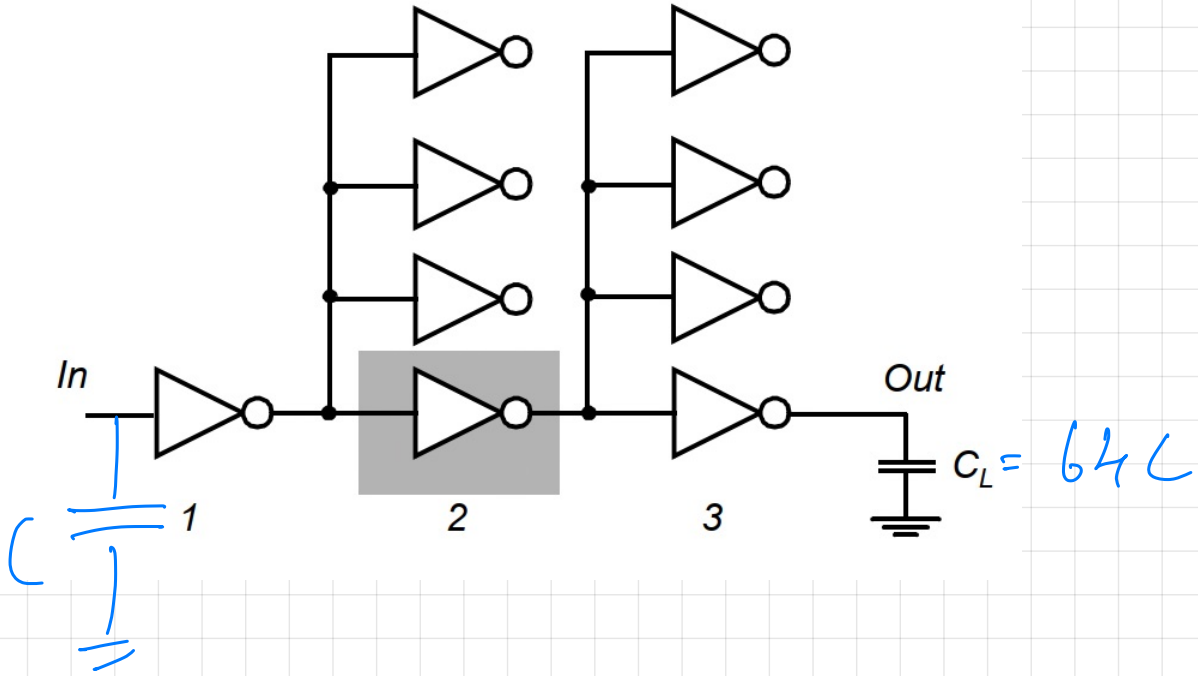


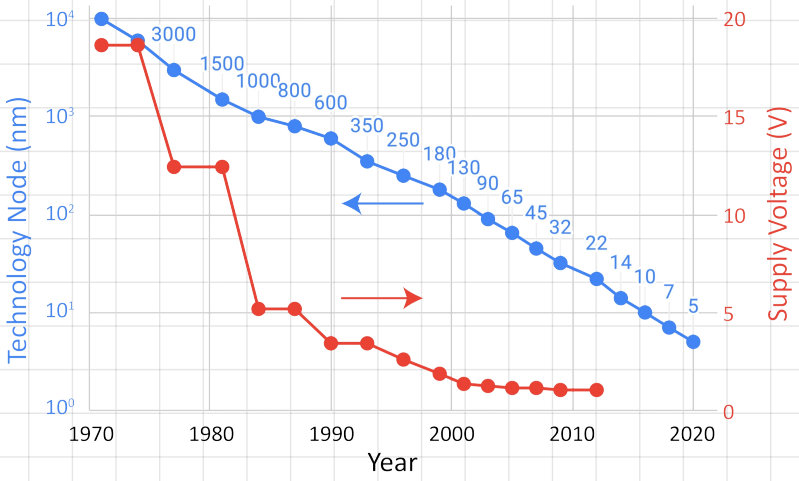
$C_{overhead} = fC + f^2C + f^3C + \cdots + f^{N-1}C$



C_{in} = 50fF

C_L = 20pF


In
Out
$C_L = 64C$
1
2
3
C


Technology Node (nm)
Supply Voltage (V)
Year
10^4
10^3
10^2
10^1
10^0
20
15
10
5
0
1970
1980
1990
2000
2010
2020
3000
1500
1000
800
600
350
250
180
130
90
65
45
32
22
14
10
7
5