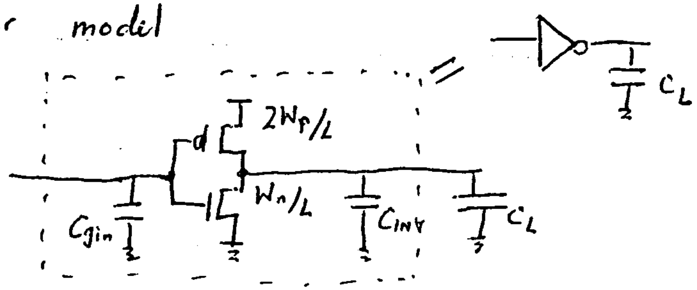
CEG3470 6/10/03

No. Date

Inverter model



Suppose $L_{min} = 0.25\mu m$

$W_p = 2W_n = 2W$

Assuming equal rise & fall times

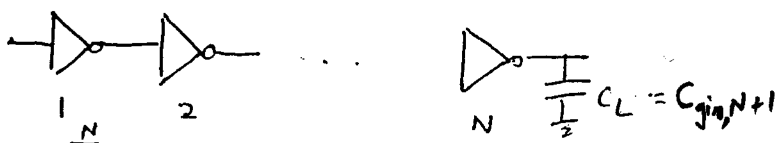
$R_p = R_n = R_W$

Since $C_{gin} \propto W$ and $C_{INT} \propto W$, $C_{gin} \propto C_{INT}$

let $C_{INT} = \gamma C_{gin}$ (turns out $\gamma \approx 1$)

Delay
$$t_p = 0.69 R_W (C_{INT} + C_L)$$
$$= K R_W C_{INT}\left(1 + \frac{C_L}{C_{INT}}\right)$$

Inverter chain



$$t_p = \sum_{i=1}^{N} K R_{W,i} C_{INT,i}\left(1 + \frac{C_{L,i}}{C_{INT,i}}\right)$$

But

$K R_{W,i} C_{INT,i} = t_{po}$ ($\uparrow W$ causes $R_W \downarrow$ & $C_{INT,i} \uparrow$ proportionally)

$C_{L,i} = C_{gin,i+1}$

$C_{INT,i} = \gamma C_{gin,i}$

$$t_p = t_{po} \sum_i \left(1 + \frac{C_{gin,i+1}}{\gamma C_{gin,i}}\right) \qquad C_{gin,N+1} = C_L$$

Given N, optimal tapering which minimises t_p is

$$\frac{C_{gin,j+1}}{C_{gin,j}} = \frac{C_{gin,j}}{C_{gin,j-1}} = f$$

each stage has the same delay

$$t_{po}(1 + f/\gamma)$$

entire chain has delay

$$t_p = N t_{po}(1 + f/\gamma)$$

If $F = \frac{C_L}{C_{gin,1}}$ then $f = \sqrt[N]{F}$

Optimal value of N found by $\frac{\partial t_p}{\partial N} = 0$

$$f = e^{1 + \gamma/f} \quad (\text{typ. } \gamma \approx 1,\ \text{set } f = 4)$$