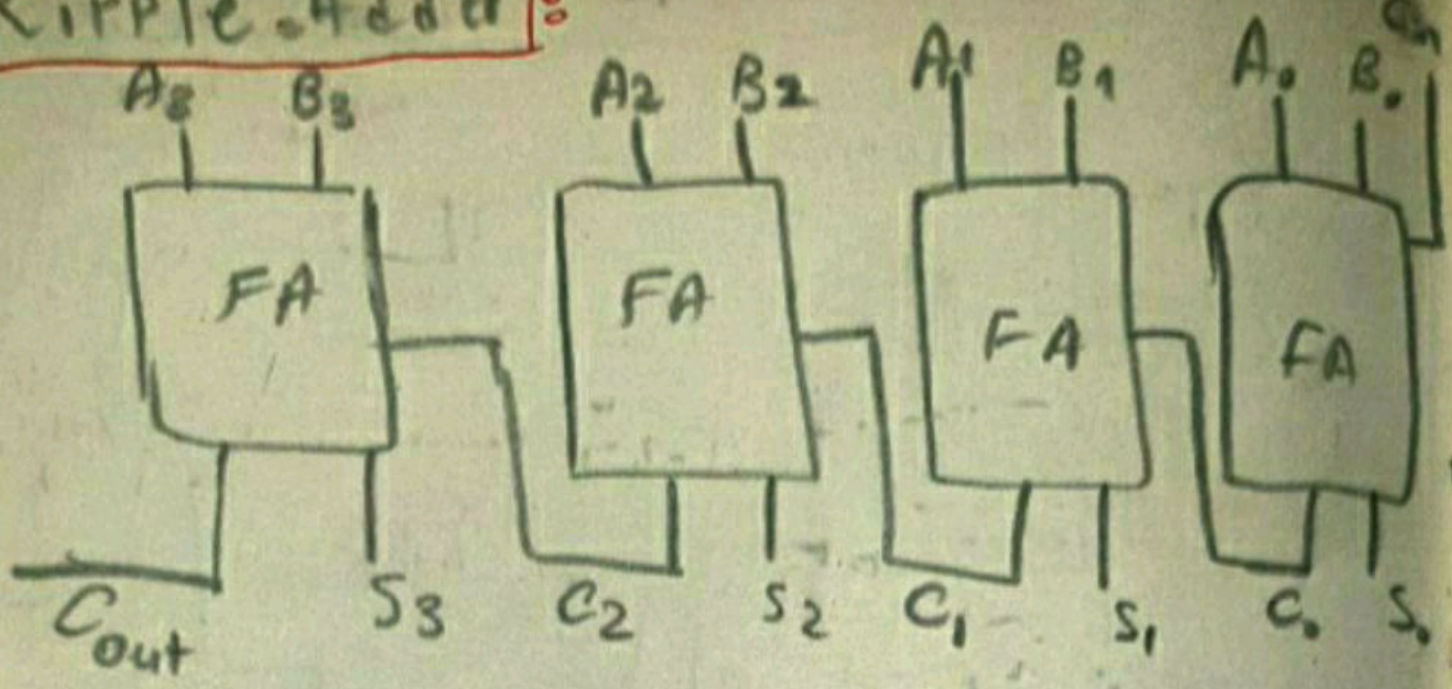
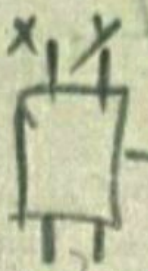
Ripple Adder:





FA ←

carry = xy + xz + yz

S = x ⊕ y ⊕ z

Cost = 5g , delay(sum) = d , delay(carry) = 2d

تأخیر و هزینه Ripple Adder:

* delay(sum) = $(n-1)2d + d$ $\xrightarrow{n=4}$ delay(sum) = 7d
* " (Carry) = $2nd$ $\xrightarrow{n=4}$ delay(Carry) = 8d
* Cost = $n \times 5g = 5ng$ $\xrightarrow{n=4}$ 20g

Carry_Lookahead Adder

$C_0 = \underbrace{A_0 B_0}_{G_0} + C_{in}\underbrace{(A_0 + B_0)}_{P_0}$

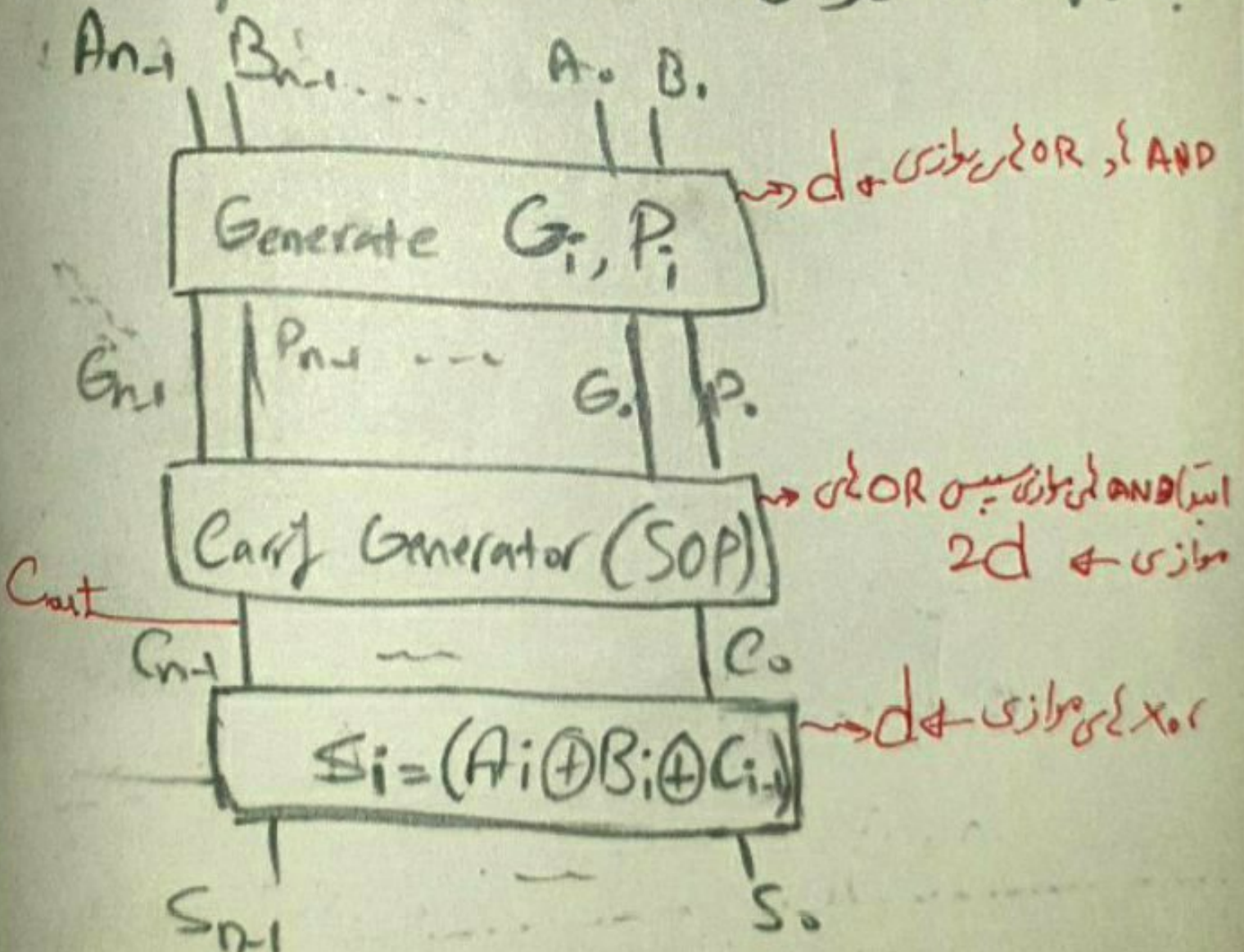
$C_1 = A_1 B_1 + C_0(A_1 + B_1) = G_1 + P_1 G_0 + P_1 P_0 C_{in}$

$\vdots$

$C_{n-1} = C_{out} = G_{n-1} + G_{n-2} P_{n-1} + G_{n-3} P_{n-2} P_{n-1} + \cdots$

$+ C_{in} P_0 \cdots P_{n-1}$

پس همه Carry ها را همزمان و موازی می‌توانیم بدست آوریم.



محاسبه Cost: لایه‌ی آخر ← Xor تا n

لایه‌ی اول ← AND تا n , OR تا n

$3n\,g$ ← ①

لایه‌ی وسط: هر carry یک OR دارد ← تا n ②

$C_0 \rightsquigarrow 1\,AND$

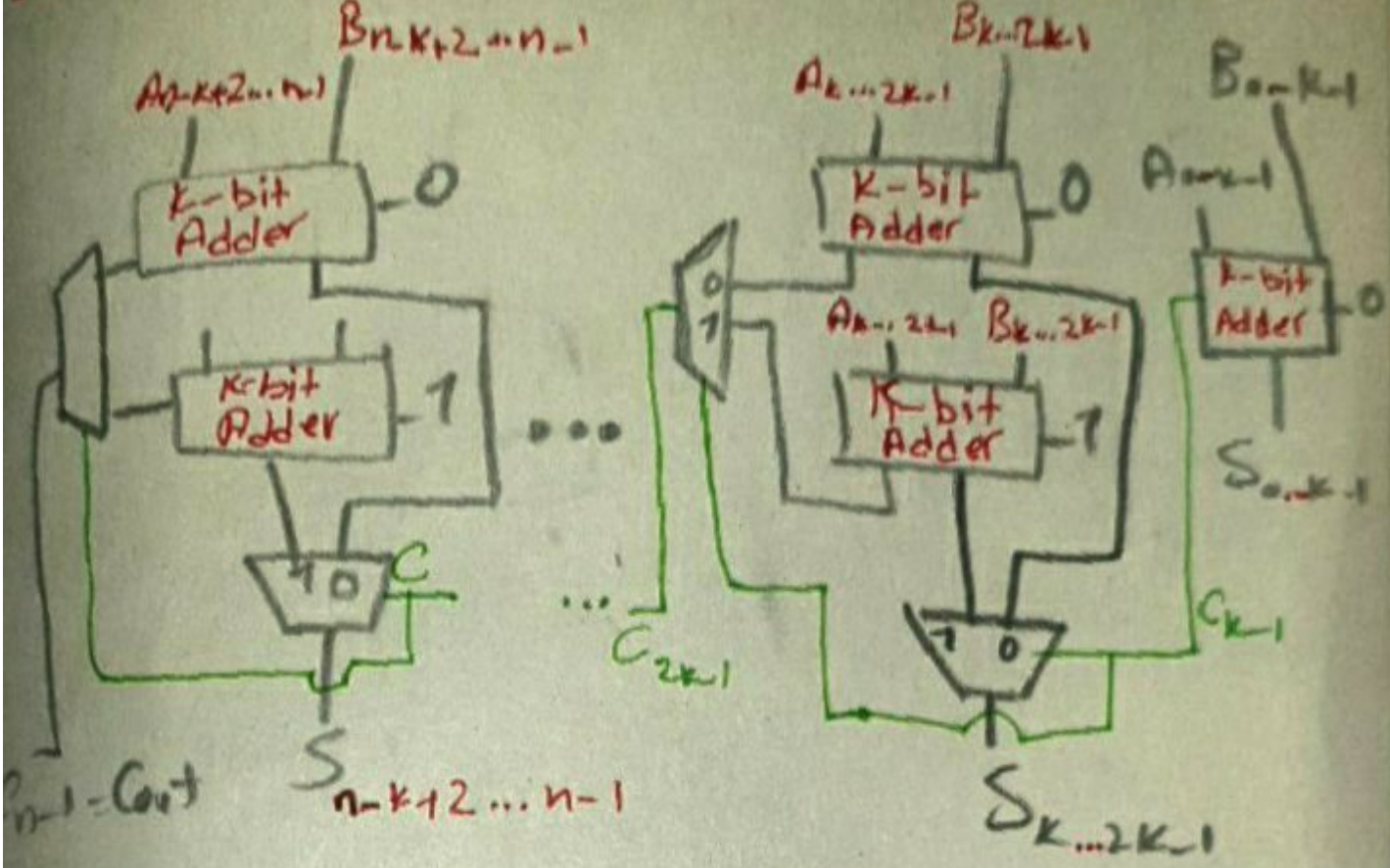
$C_1 \rightsquigarrow 2\,AND$

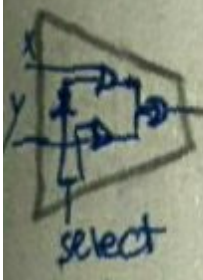
$\ldots$ $C_{n-1} \rightsquigarrow n\,AND$ } $\rightarrow \frac{n(n+1)}{2}$ ③

* delay(sum) = 4d
* delay(Curry) = 3d

$$\boxed{\text{Cost } \underline{\underline{\overset{①,②}{,③}}} \left(4n + \frac{n(n+1)}{2}\right)g = \frac{n(n+9)}{2}}$$

Carry Select Adder: حالت یکنواخت





MUX 2→1 : delay = 3d

Cost = 4g

MUX 2K→1K : delay = 3d

Cost = 4K g

CSA → delay(sum) = $2k\,d + 3\left\lfloor \frac{n}{k} \right\rfloor d$

عمدی RA {موازی کار می کنند

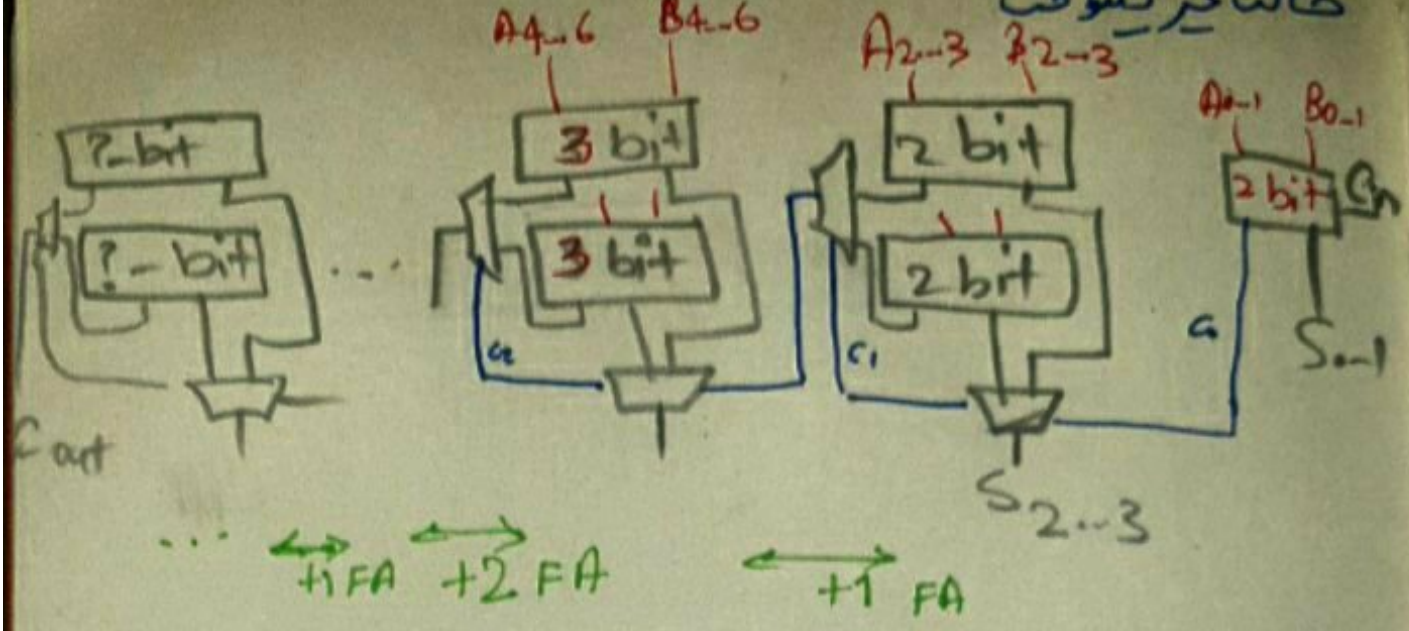
{MUX

$$Cost = \left(\left\lfloor \frac{n}{k} \right\rfloor + 1\right) 5k\,g + \left\lfloor \frac{n}{k} \right\rfloor (4k + 4)\,g$$

RAs

MUXs

حالت غیر یکنواخت



* حالت غیر یکنواخت برای جمع کننده ی ۸ بیتی

همانند حالت یکنواخت با K=2 می شود

مقایسه ۳ نوع Adder برای ۸ بیت :

Ripple Adder8 delay(sum) = 7d
delay(carry) = 8d
Cost = 20g

CLA3 delay(sum) = 4d
" (Carry) = 3d
cost = $\frac{4 \times 13}{2}$ = 26g

CSA8 delay(sum/carry) $\overset{K=2}{=}$ 4d + 6d = 10d
Cost $\overset{K=2}{=}$ 30 + 24 = 54g