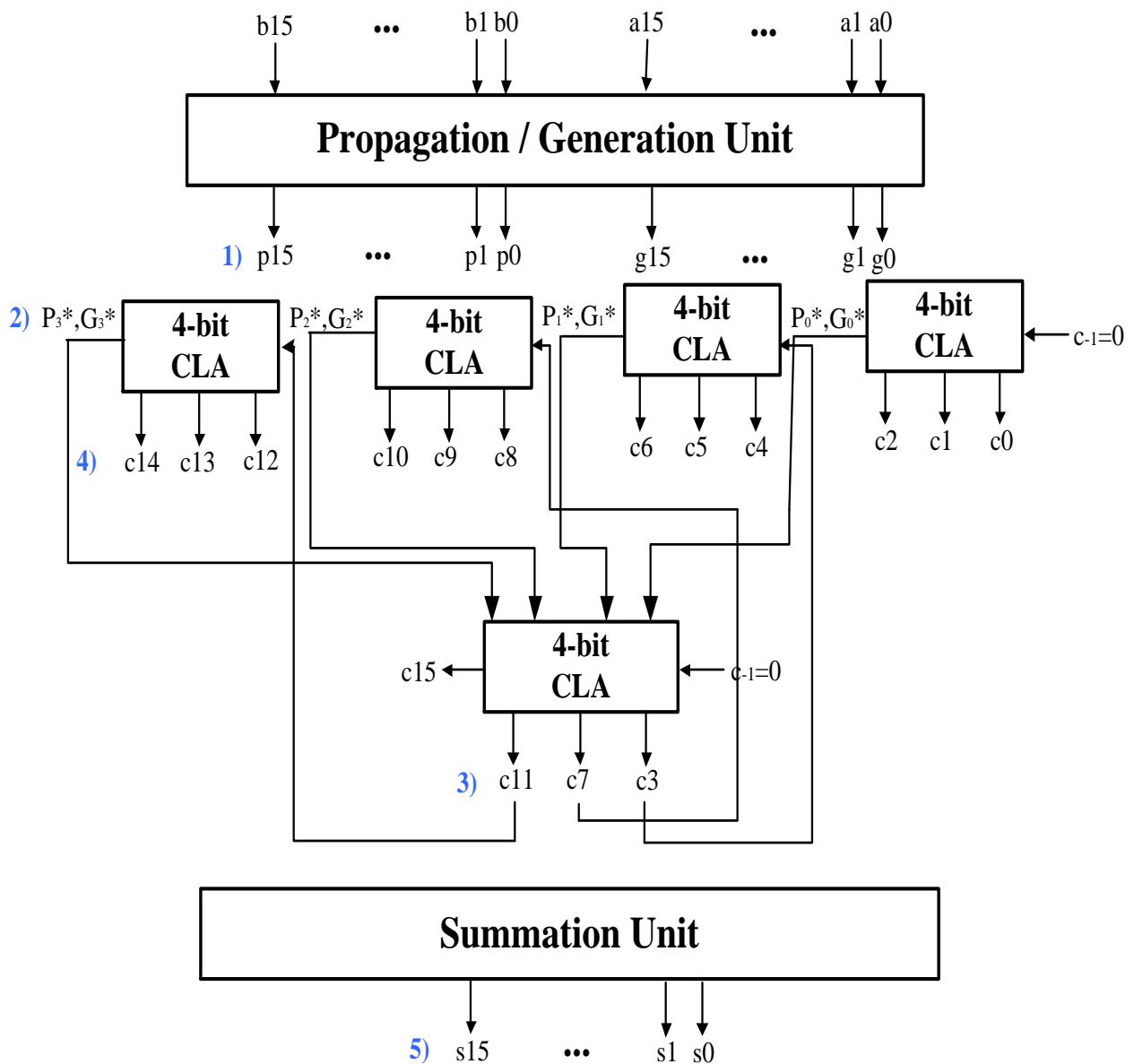


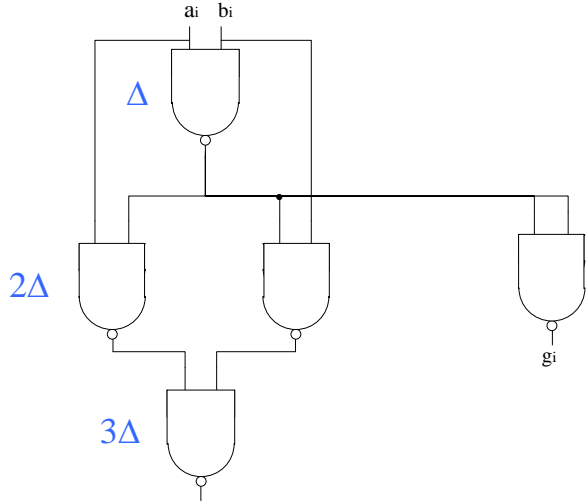
2-Level 16-bit Carry Look-Ahead Adder

Assume that 4-bit Carry Look-Ahead(CLA) units are available for parallel adder construction.

$$A = a_{15}a_{14} \dots a_0, \quad B = b_{15}b_{14} \dots b_0, \quad G = g_{15}g_{14} \dots g_0, \quad P = p_{15}p_{14} \dots p_0, \quad C_{-1} = 0$$



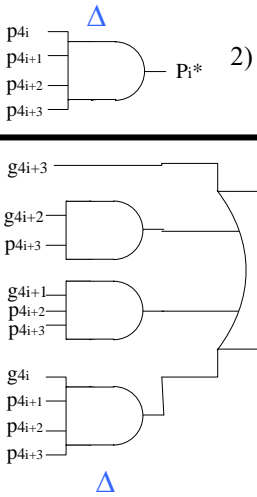
1)



$$g_i = a_i b_i, \quad i = 0, 1, 2, \dots, 15$$

$$p_i = a_i \oplus b_i, \quad i = 0, 1, 2, \dots, 15$$

2)



$$P_i^* = p_{4i} p_{4i+1} p_{4i+2} p_{4i+3}, \quad i = 0, 1, 2, 3$$

$$G_i^* = g_{4i+3} + g_{4i+2} p_{4i+3} + g_{4i+1} p_{4i+2} p_{4i+3} + g_{4i} p_{4i+1} p_{4i+2} p_{4i+3}, \quad i = 0, 1, 2, 3$$

3)

$$C_3 = G_0^* + P_0^* C_{-1}$$

$$C_7 = G_1^* + P_1^* C_3 = G_1^* + G_0^* P_1^* + P_0^* P_1^* C_{-1}$$

$$C_{11} = G_2^* + P_2^* C_7 = G_2^* + G_1^* P_2^* + G_0^* P_1^* P_2^* + P_0^* P_1^* P_2^* C_{-1}$$

$$C_{15} = G_3^* + P_3^* C_{11} = G_3^* + G_2^* P_3^* + G_1^* P_2^* P_3^* + G_0^* P_1^* P_2^* P_3^* + P_0^* P_1^* P_2^* P_3^* C_{-1}$$

Applying a similar scheme as step 2), the delay of step 3) is also 2Δ .

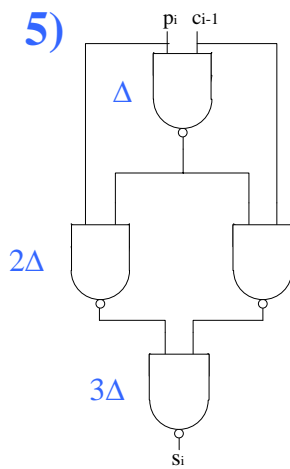
4)

$$c_{i+1} = g_{i+1} + c_i p_{i+1}, \quad i = -1, 3, 7, 11$$

$$c_{i+2} = g_{i+2} + g_{i+1} p_{i+2} + c_i p_{i+1} p_{i+2}, \quad i = -1, 3, 7, 11$$

$$c_{i+3} = g_{i+3} + g_{i+2} p_{i+3} + g_{i+1} p_{i+2} p_{i+3} + c_i p_{i+1} p_{i+2} p_{i+3}, \quad i = -1, 3, 7, 11$$

Applying a similar scheme as step 2), the delay of step 4) is also 2Δ .



$$s_i = p_i \oplus c_{i-1}, \quad i = 0, 1, 2, \dots, 15$$

Therefore, total time delay of 2-level 16 bit CLA is $3\Delta + 2\Delta + 2\Delta + 2\Delta + 3\Delta = 12\Delta$