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EECS 3201: Digital Logic Design Lecture 18

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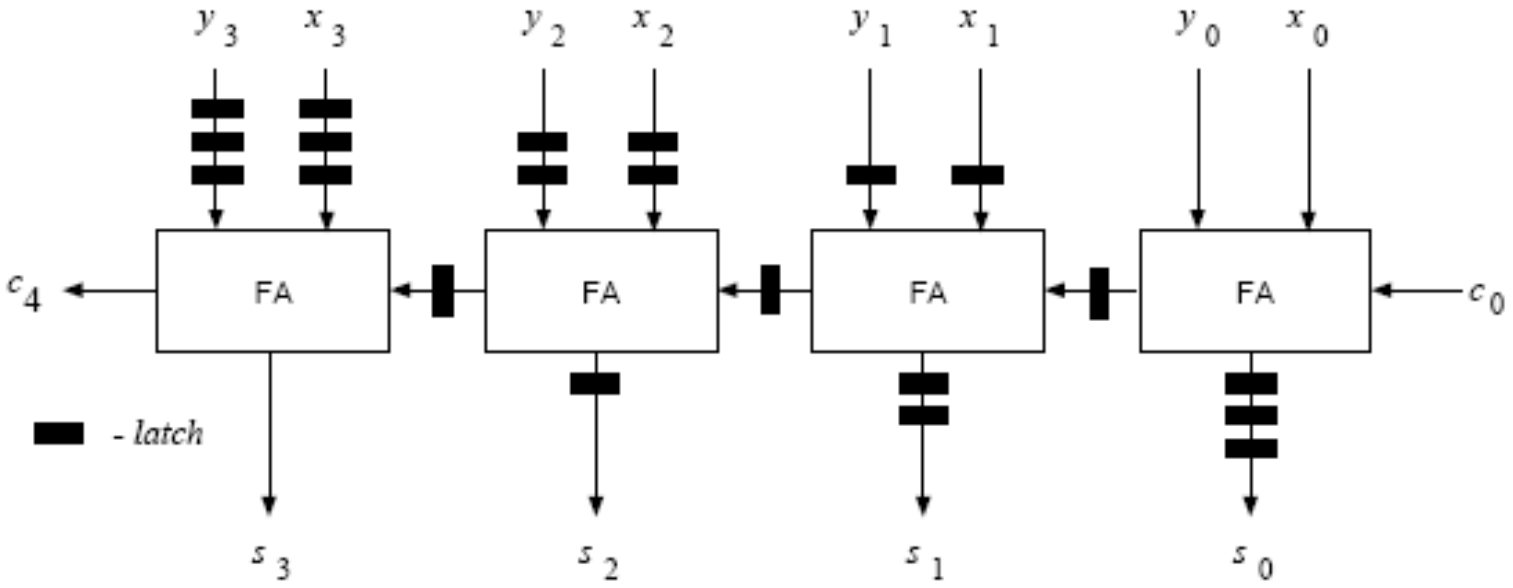
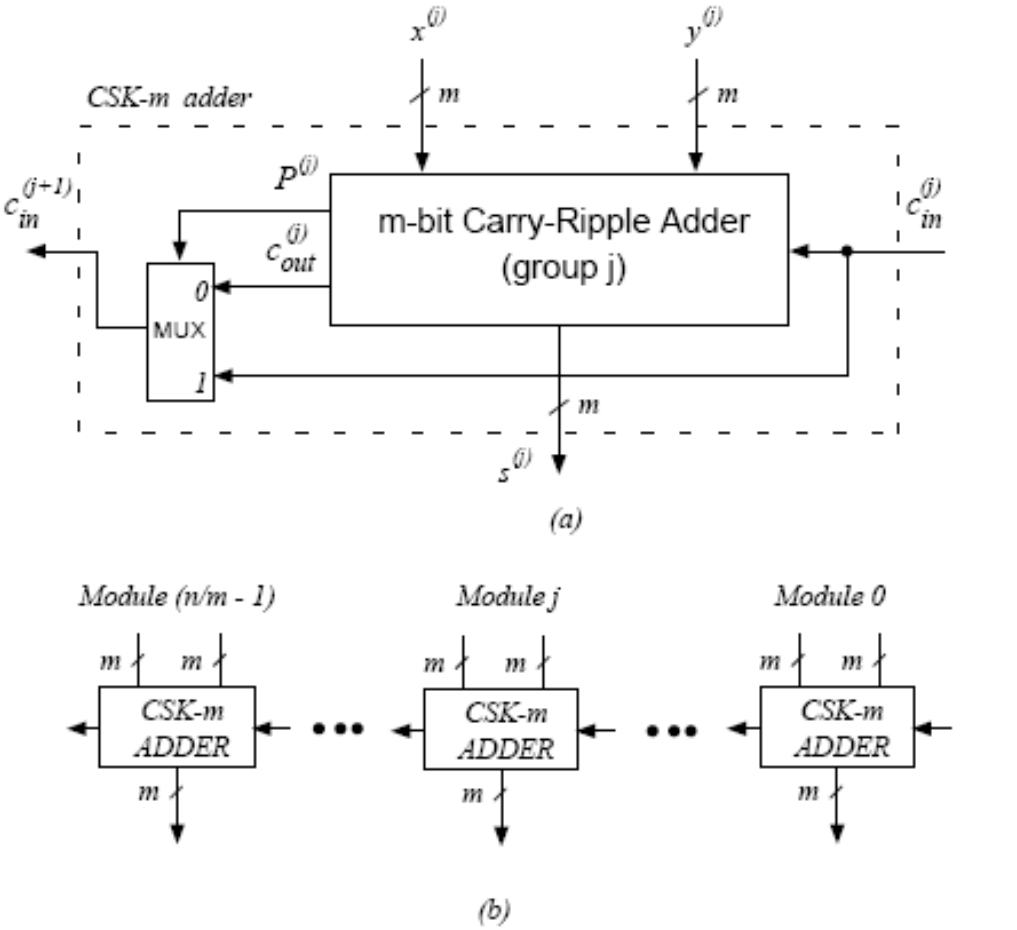
Pipelined Adder



Pipelined carry-ripple adder (for group size of 1 and $n = 4$)

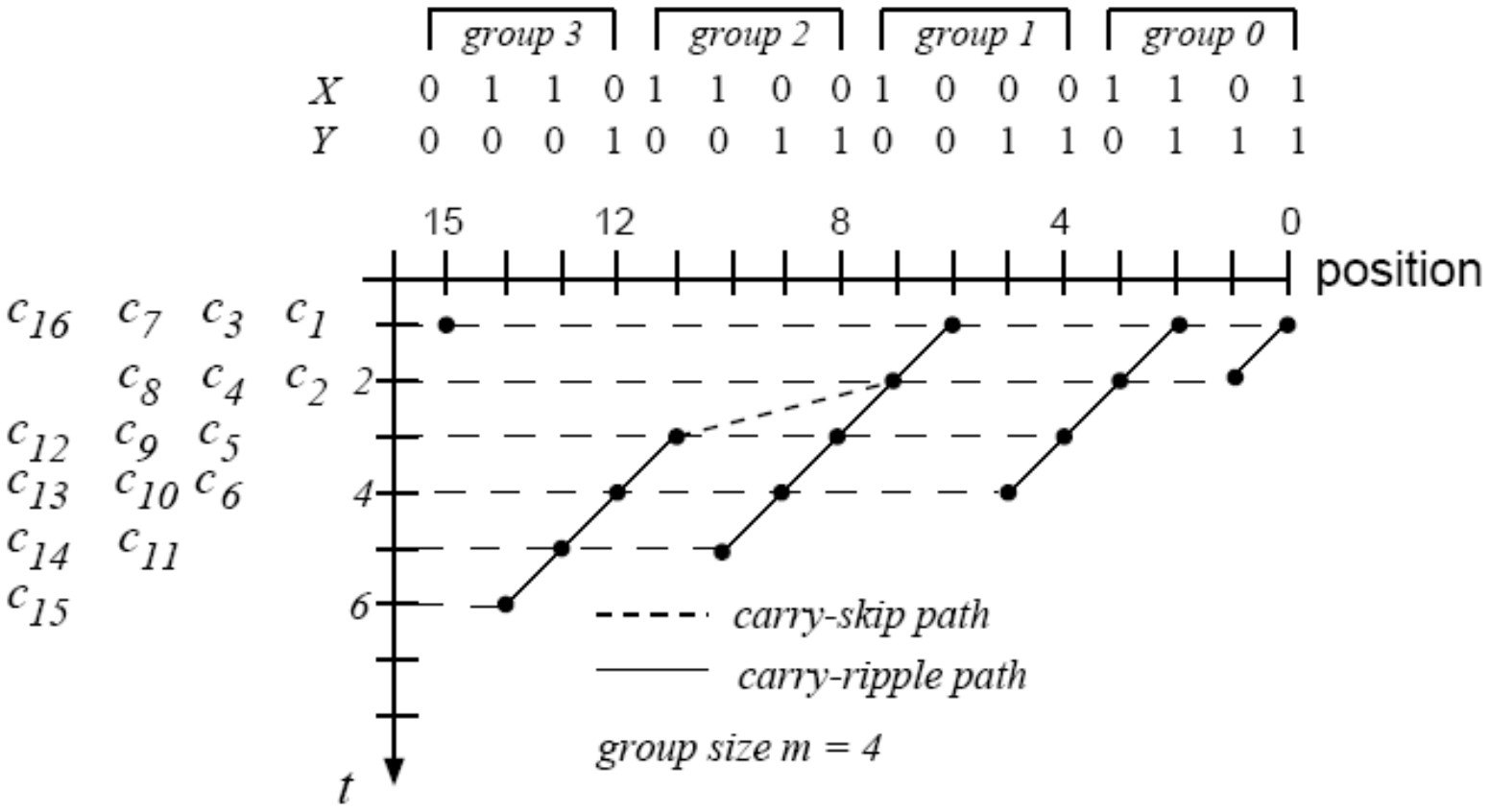
Throughput = 1/t_{group}

Carry-Skip Adder



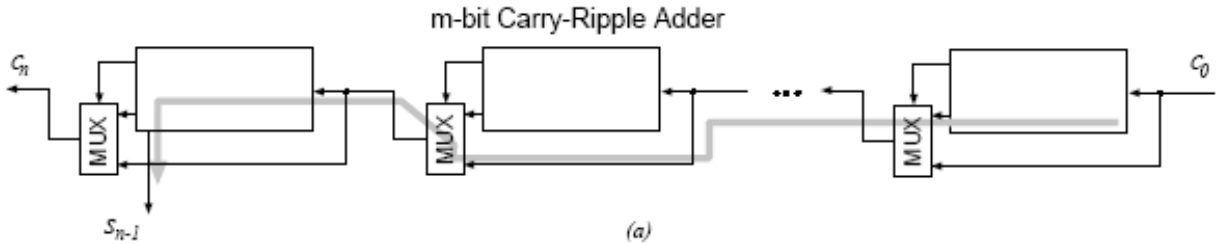
Carry-skip adder: (a) A group with carry bypass. (b) n-bit CSK adder.

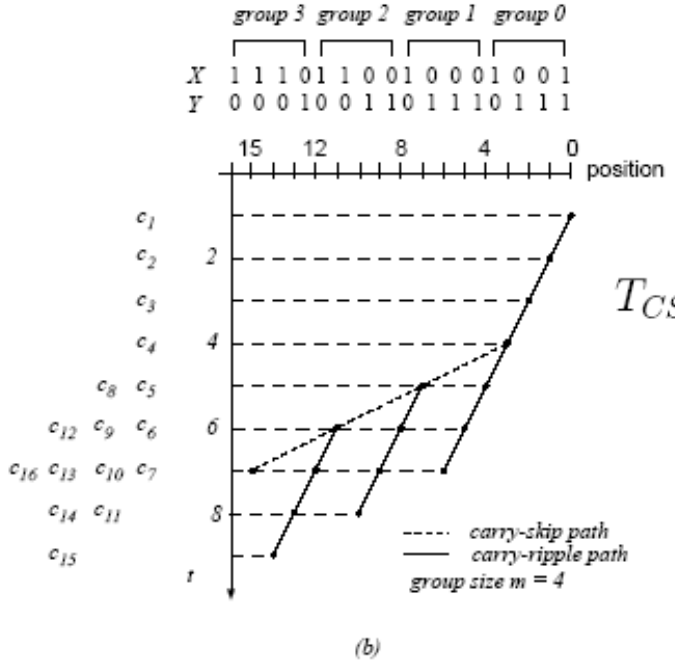
Carry Chains in CSA



Carry chains in carry-skip adder: A case with several carry chains.

Critical Path for CSA

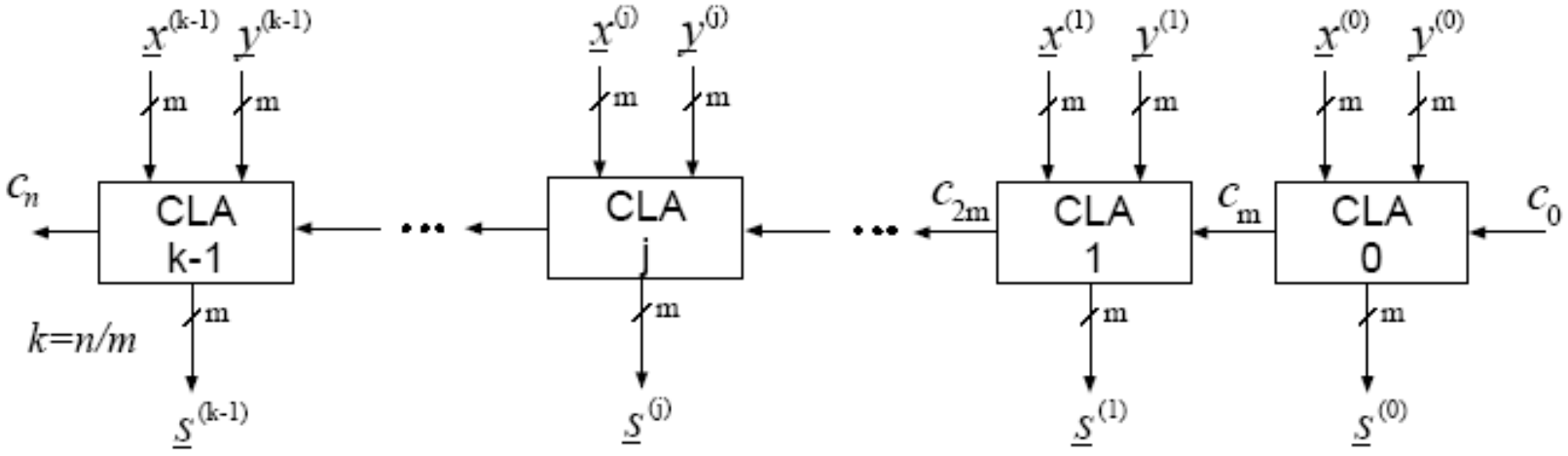




$$T_{CSK} = mt_c + t_{mux} + (\frac{n}{m} - 2)t_{mux} + (m-1)t_c + t_s$$
$$= (2m-1)t_c + (\frac{n}{m} - 1)t_{mux} + t_s$$

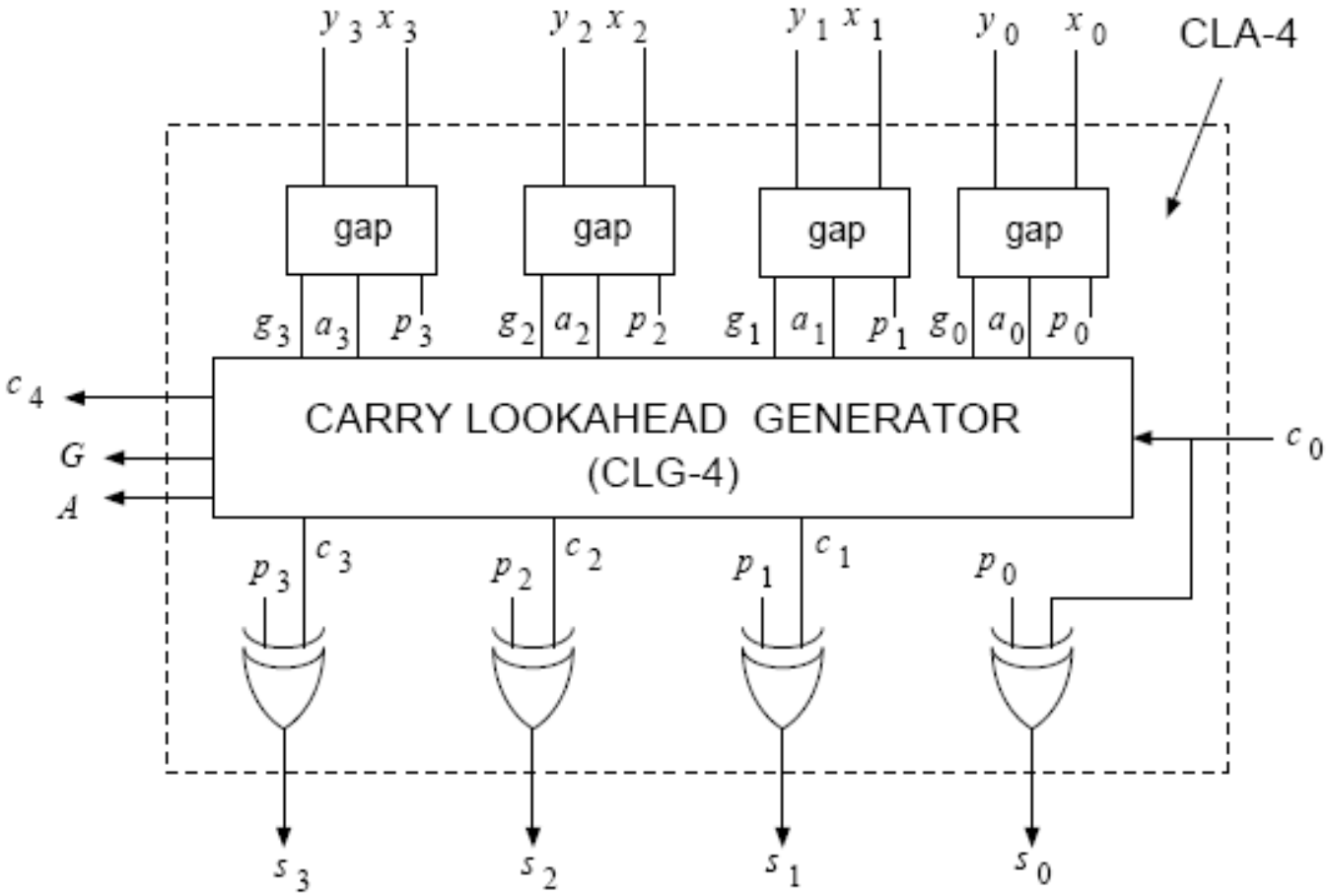
(a) Critical path in carry-skip adder. (b) The worst-case situation for $n = 16$.

Carry-Lookahead Adder



One-level carry-lookahead adder

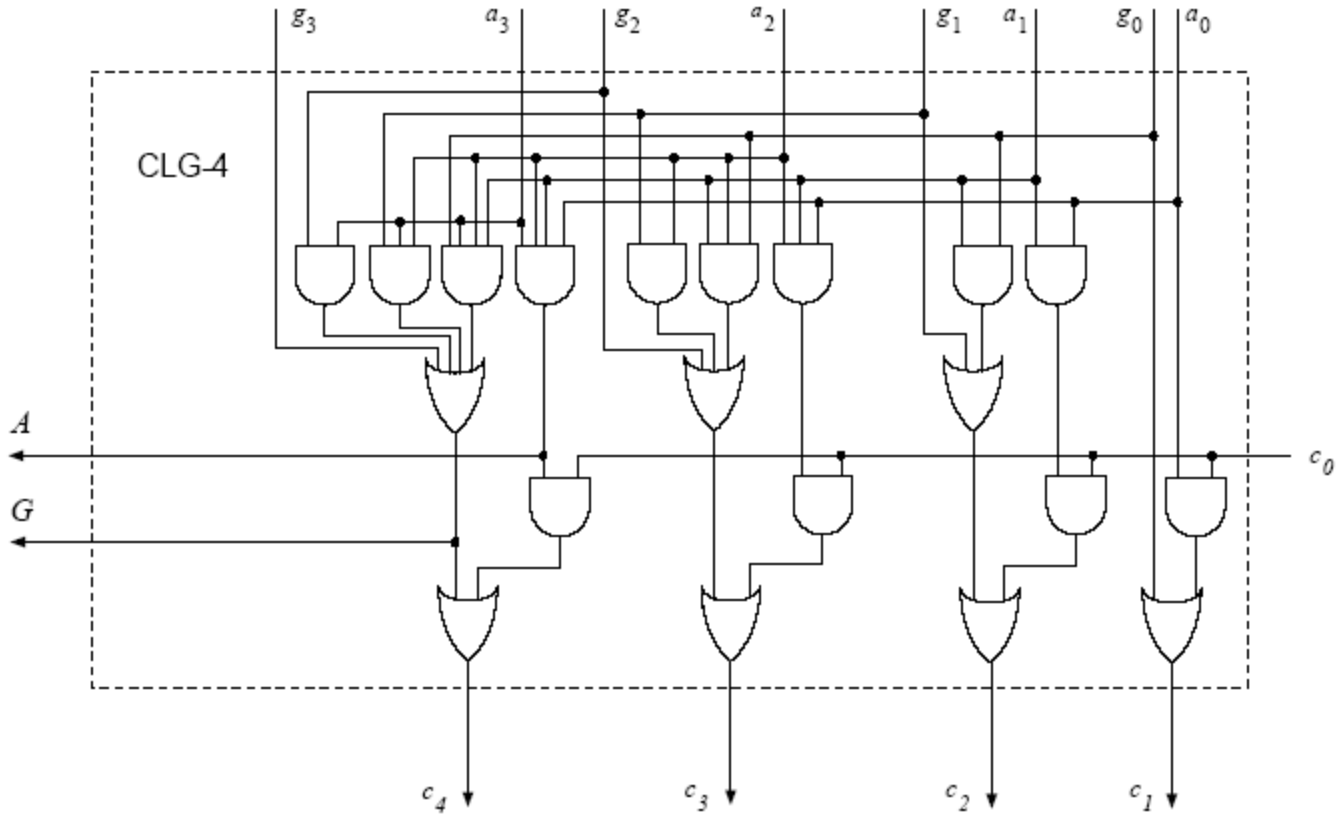
Carry-Lookahead Module



Carry-lookahead adder module ($m = 4$).

$$T_{1-CLA} = t_{a,g} + \frac{n}{m} t_{clg} + t_s$$

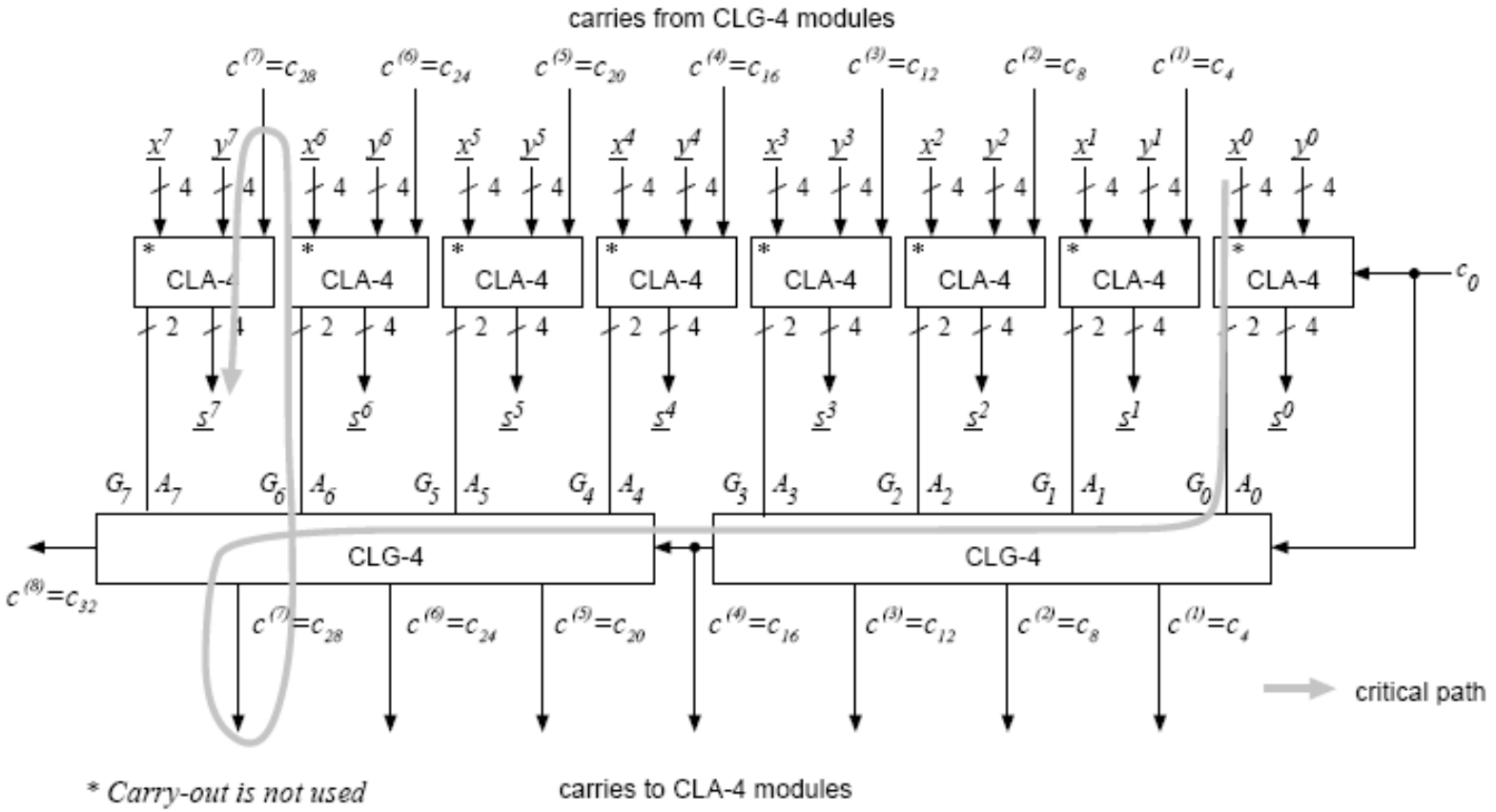
Carry-Lookahead Generator



4-bit carry-lookahead generator CLG-4.

$$c_{i+1} = g_i + a_i g_{i-1} + a_i a_{i-1} g_{i-2} + \cdots + (a_i a_{i-1} \cdots a_0) c_0$$

Two-Level Carry Lookahead Adder



Two-level carry-lookahead adder ($n = 32$)

$$T_{2-CLA} = t_{a,g} + t_{A,G} + \frac{n}{pm} t_{clg} + t_{clg} + t_s$$

References

- Milos D. Ercegovac and Tomas Lang, “Digital Arithmetic”, Morgan Kaufmann Publishers, an imprint of Elsevier Science, 2004