

Anna University - MIT CAMPUS

Digital system Design

Assignment -1

Name : S. Ajay Kumar

Roll no : 2024503701

## Binary Adder :

\* A binary adder is a circuit used to add two binary numbers. It takes two binary numbers. It takes two binary numbers as input and gives sum of the two binary numbers and their carry as output.

\* ALU uses a binary adder for additions. Binary Adders can be implemented using various configurations. But most of the common configuration is using Half Adder and Full Adder circuits.

## Types :

- \* Half Adder
- \* Full Adder
- \* Ripple-Carry Adder (RCA)
- \* Carry-Lookahead Adder (CLA)

## Ripple-Carry Adder :

→ A ripple carry adder is a type of binary adder used to add two multi-bit binary numbers. It is constructed by connecting several full adders in cascade, such that the carry output of one stage becomes the carry input of the next stages.

→ Since the carry signal must propagate through each stage sequentially, the adder is called as Ripple carry Adder.

## Working :

\* Each full adder adds three inputs : the two operands bits ( $A_i^*$ ,  $B_i^*$ ) and the carry from the previous stage ( $C_{i-1}^*$ ).

\* The sum output is given by :

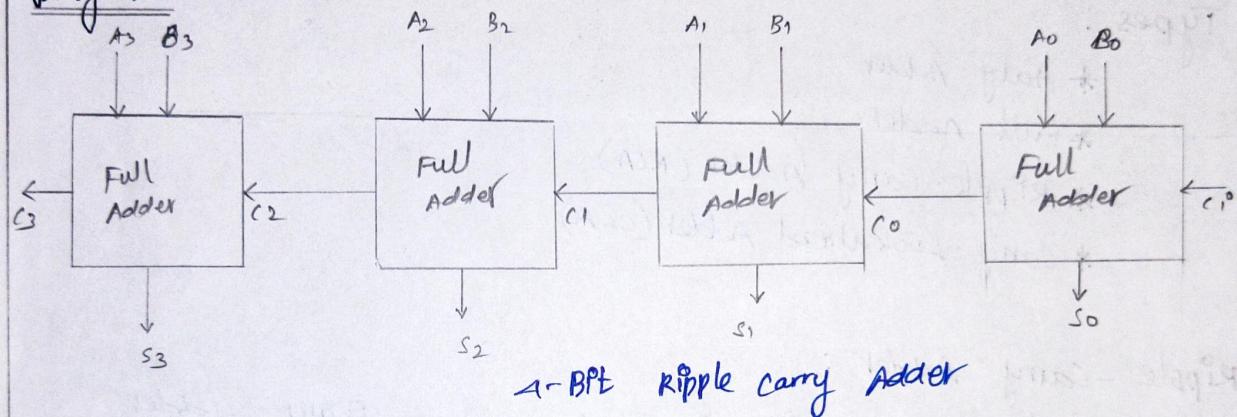
$$S_i = A_i \oplus B_i \oplus c_i$$

$$C_{i+1} = (A_i \cdot B_i) + (c_i \cdot (A_i \oplus B_i))$$

\* For example :

In a 4 bit RCA, there are four full adders connected in series. The final output consists of a 4 bit sum and a final carry.

Diagram :



Advantages :

- \* Simple design
- \* Cost - Effective
- \* Scalability

Disadvantages :

- \* Slow operation
- \* Propagation delay increases with size.
- \* Not suitable for High-speed Application.

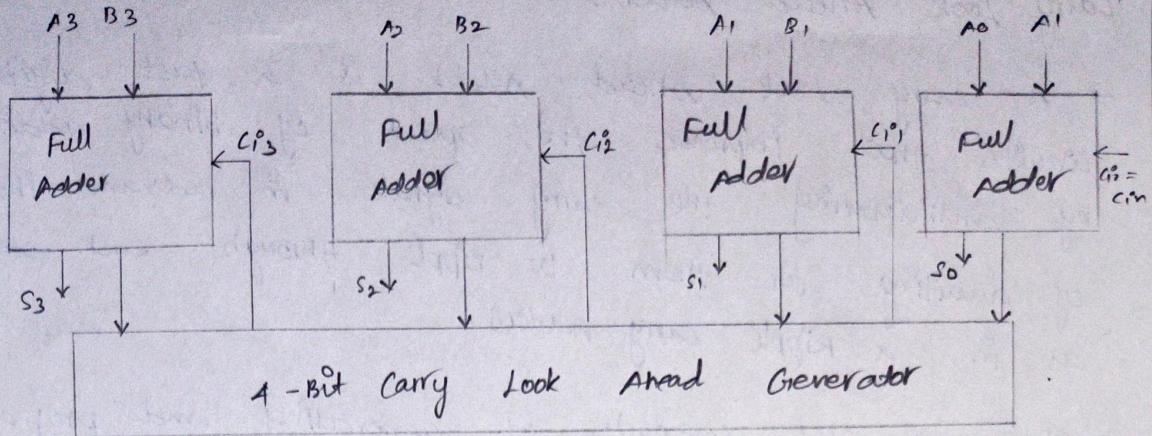
A	B	cin	S	cout
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

## Carry Look Ahead Adder:

- A carry look ahead adder is a fast digital circuit that improves the speed of binary addition by anticipating the carry signals in advance instead of awaiting for them to ripple through each stage as in a ripple carry adder.
- It uses the concepts of generating and propagate functions to calculate carries in parallel.

### Working:

- \* It works by connecting a series of full adders in cascade where the carry output of each adder is passed as the carry input to the next stage.
- \* The addition process starts from the least significant bit (LSB) and moves toward the most significant bit (MSB).
- \* At each stage, the full adders adds the two input bits along with the carry from the previous stage to produce a sum and a new carry.
- \* Since the carry must ripple through each full adder before the final result is obtained the overall addition is slow and the delay increases as the numbers of bits increase.



### Advantages :

- \* High Speed
- \* Efficient for Large word size
- \* Widely used in CPU

A	B	C	C+1	Condition
0	0	0	0	No carry
0	0	1	0	Generate
0	1	0	0	
0	1	1	1	No carry propagate
1	0	0	0	
1	0	1	1	
1	1	0	1	Carry Generate.
1	1	1	1	

### Disadvantages :

- \* Complex circuitry
- \* Hardware cost increases
- \* Difficult to design for very large bit sizes.