INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

ASSIGNMENT-3

Computer Organization and Architecture Laboratory

Group-24

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1 Ripple Carry Adder

1.1 Half Adder

Truth Table:

Half-Adder			
a	b	sum	carryOut
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

1.2 Full Adder

Truth Table:

Full-Adder				
a	b	carryIn	sum	carryOut
0	0	0	0	0
0	1	0	1	0
1	0	0	1	0
1	1	0	0	1
0	0	1	1	0
0	1	1	0	1
1	0	1	0	1
1	1	1	1	1

1.3 Ripple Carry Adders

1.3.1 Half Adder

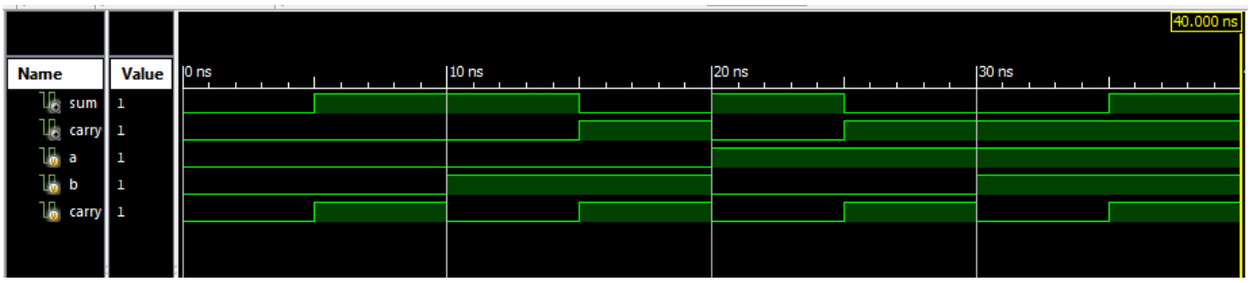

Figure 1: Half adder

Delay: 1.066 ns (0.125(logic) + 0.941(route))

1.3.2 Full Adder

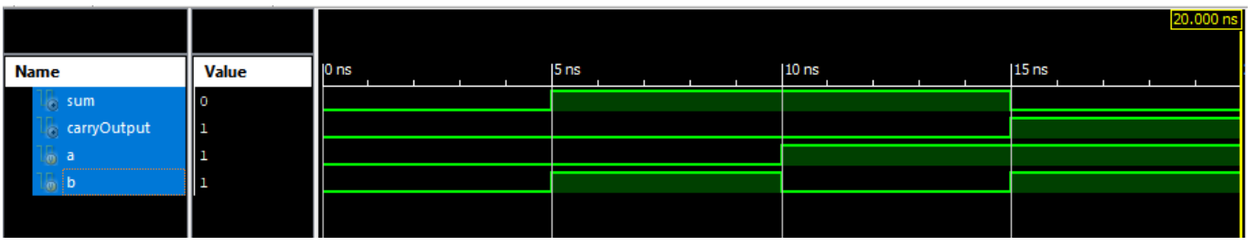

Figure 2: Full adder

Delay: 1.246 ns (0.125(logic) + 1.121(route))

1.3.3 8-bit Ripple Carry Adder

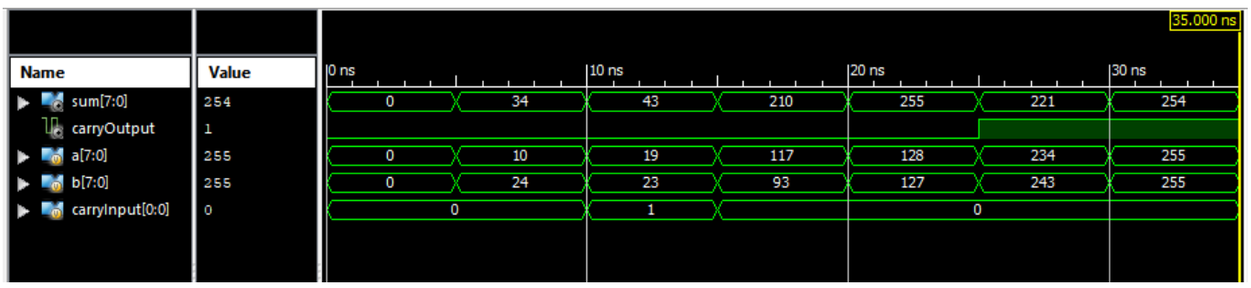

Figure 3: 8-bit Ripple Carry Adder

Delay: 3.471 ns (0.497(logic) + 2.974(route))

1.3.4 16-bit Ripple Carry Adder

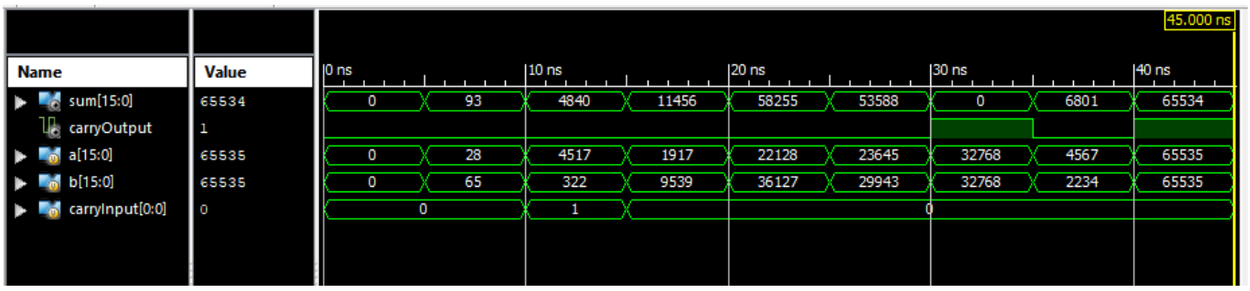

Figure 4: 16-bit Ripple Carry Adder

Delay: 6.167 ns (0.993(logic) + 5.174(route))

1.3.5 32-bit Ripple Carry Adder

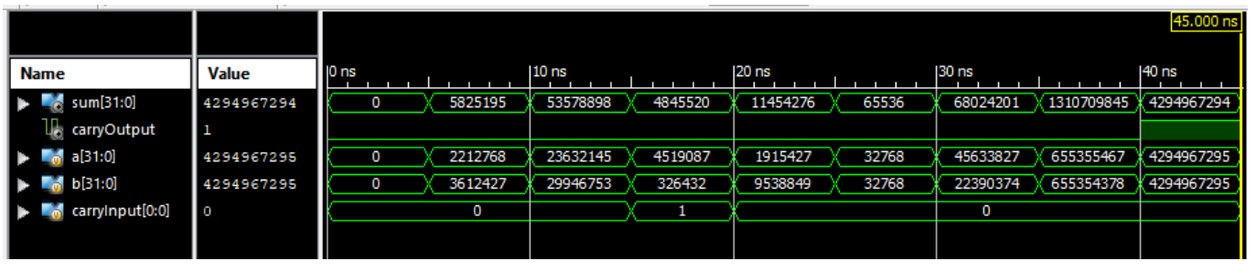

Figure 5: 32-bit Ripple Carry Adder

Delay: 11.559 ns (1.985(logic) + 9.574(route))

1.3.6 64-bit Ripple Carry Adder

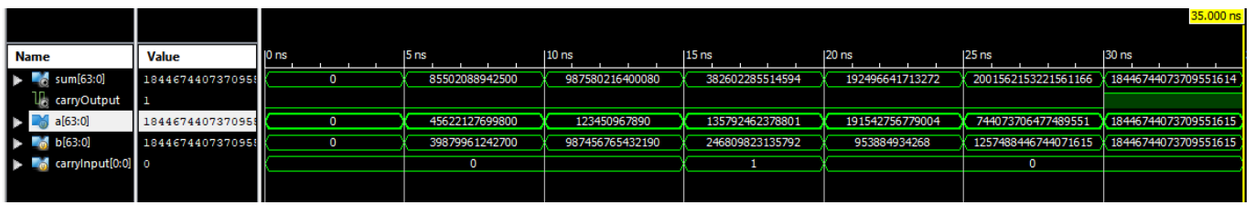

Figure 6: 64-bit Ripple Carry Adder

Delay: 22.343 ns (3.969(logic) + 18.374(route))

1.4 How can you use the above circuit, to compute the difference between two n-bit numbers?

We can calculate sum of two numbers using the ripple carry adder.

- Inputs: a , b, carryInput = 0
- output: a + b

Now we want to compute the difference between two n-bit numbers (a - b). To calculate the difference we can add 'a' with the 2's complement of 'b'. This can be achieved by adding 'a' with the bitwise complement of 'b' and setting the carryInput bit equal to 1.

$$\implies a - b = a + (2's\ complement\ of\ b)$$
$$\implies a - b = a + (bitwise\ complement\ of\ b) + 1$$

The above addition can be easily done using the ripple carry adder by giving the inputs: a, bitwise complement of b and carryInput = 1.