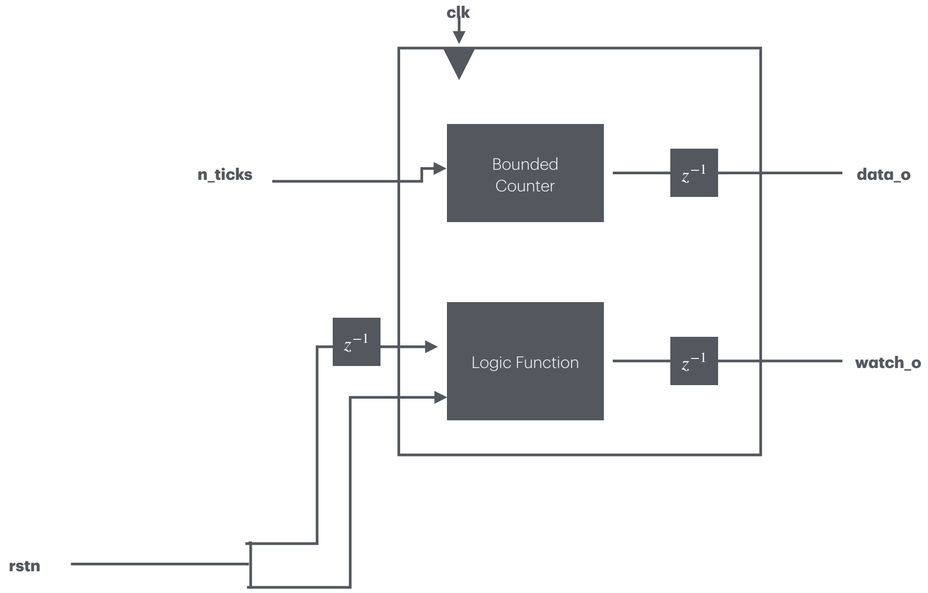
Sys-Verilog Questions Review

Some Solutions to questions from ChipIO-Dev

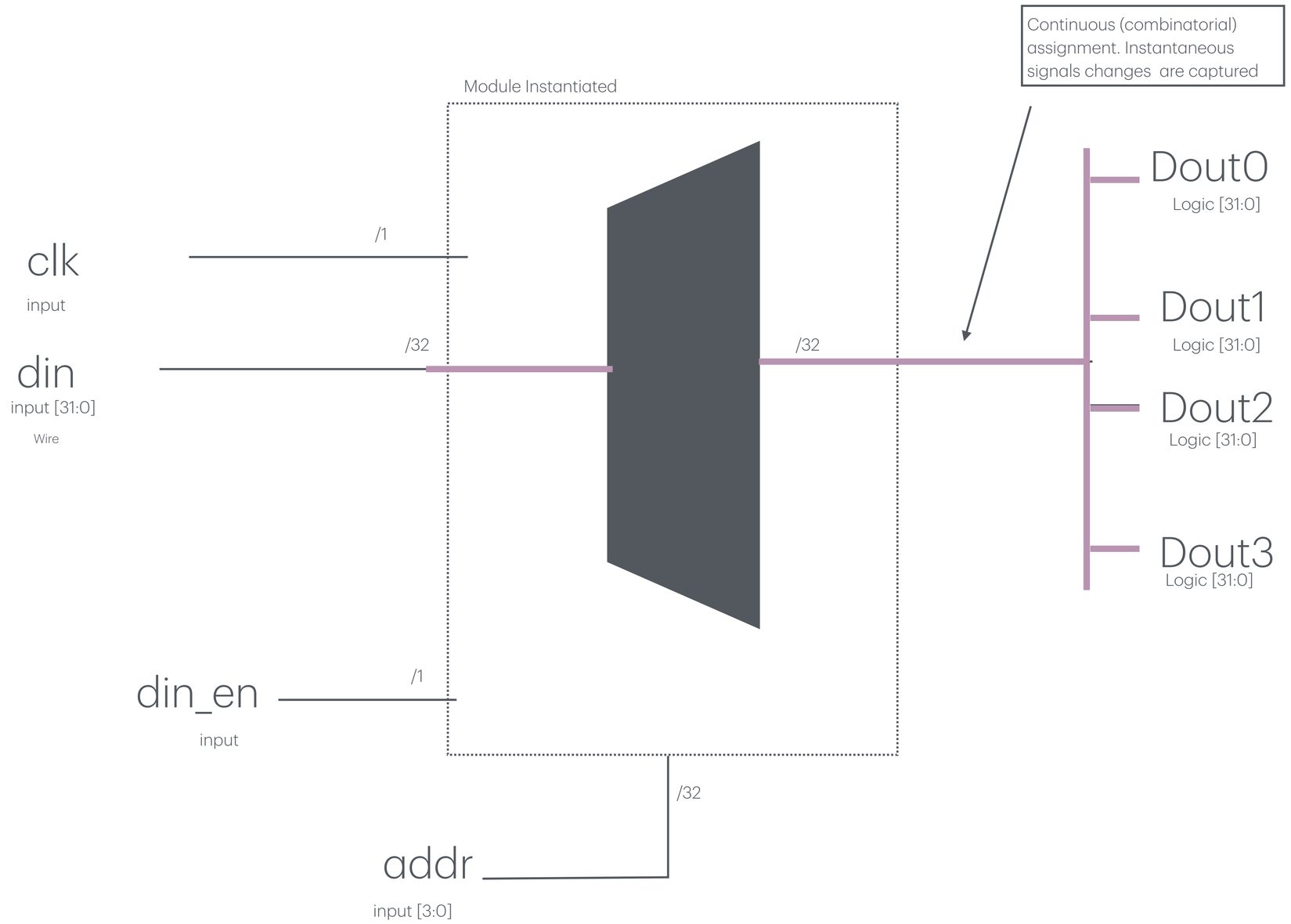
Hector “Hectron” Williams

Counter

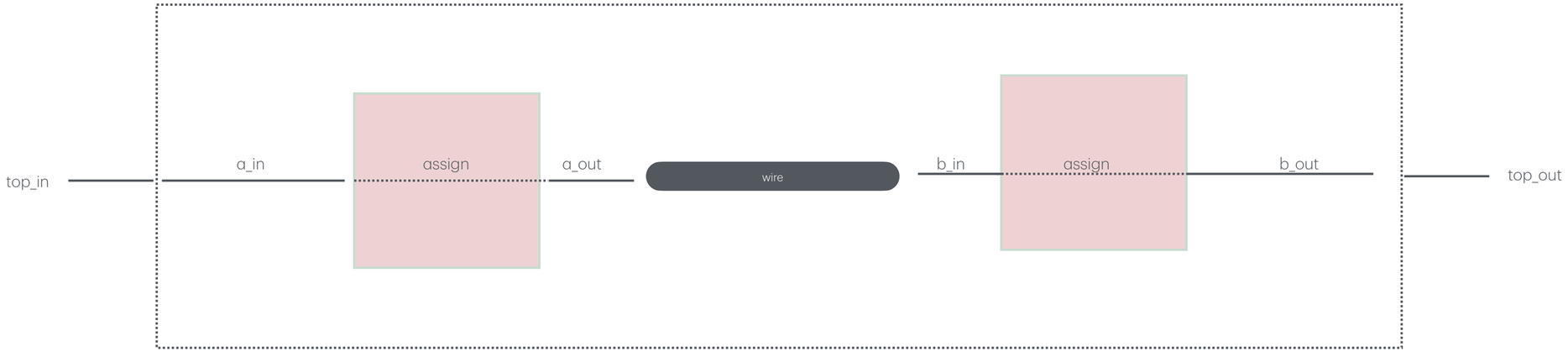
Counter


clk
n_ticks
Bounded Counter
z^{-1}
data_o
z^{-1}
Logic Function
z^{-1}
watch_o
rstn

Router

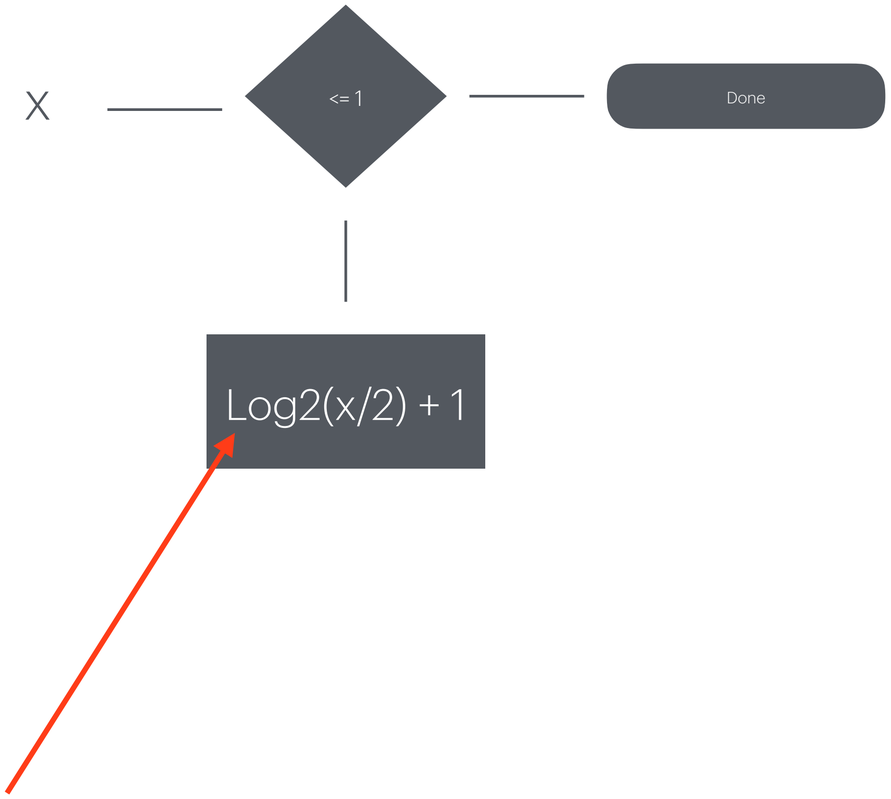

Continuous (combinatorial) assignment. Instantaneous signals changes are captured
Module Instantiated
clk
input
/1
din
input [31:0]
Wire
/32
/32
Dout0
Logic [31:0]
Dout1
Logic [31:0]
Dout2
Logic [31:0]
Dout3
Logic [31:0]
din_en
input
/1
/32
addr
input [3:0]

Connect (wire)



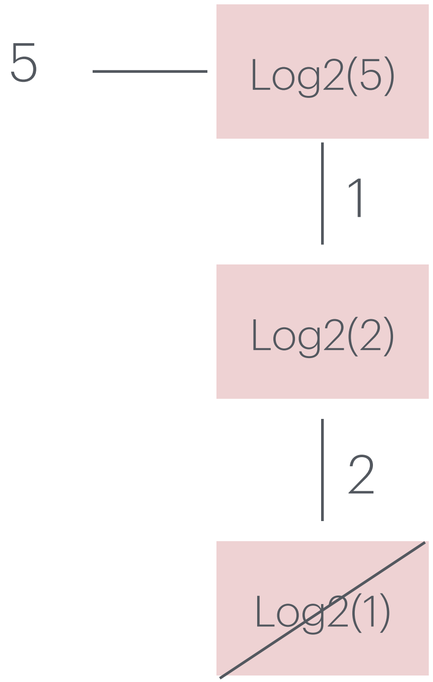
Log2

Log2



Recursion or calling the same hardware segment repeatedly

Log2(**5**)

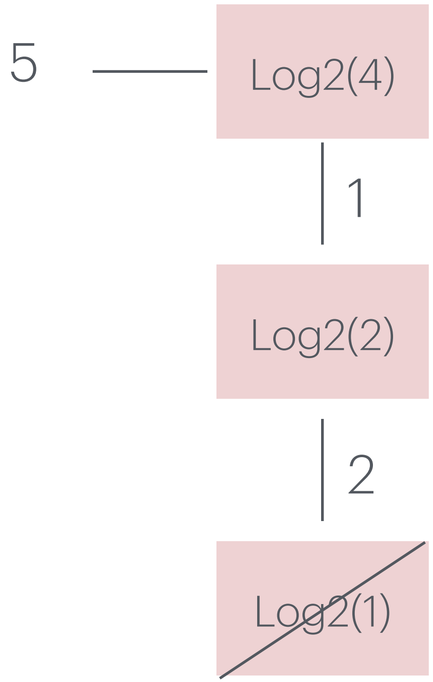


Minimum number of bits represent 5?

Min = 2

$5 > 2^2$ (increment)

Log2(**4**)



Minimum number of bits represent 5?

Min = 2

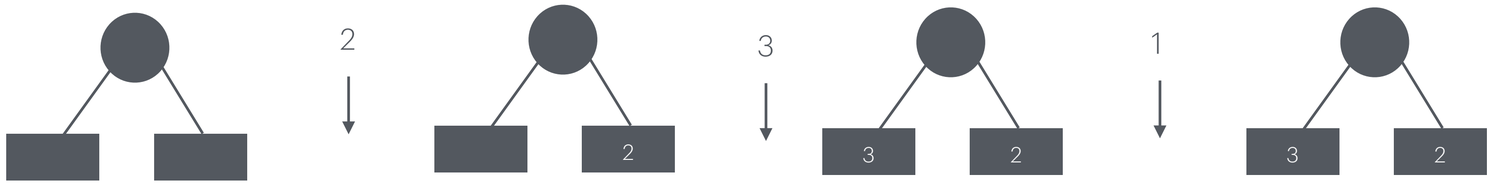
$4 \not< 2^2$ (perfect)

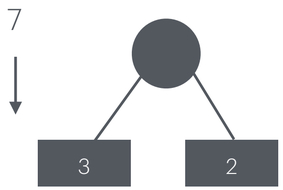
Log2 : Debug Results

VECTOR SENT [1] - [36]
VECTOR SENT [2] - [129]
VECTOR SENT [3] - [9]
VECTOR SENT [4] - [99]
VECTOR SENT [5] - [13]
VECTOR SENT [6] - [141]

VECTOR RCVD [6]
VECTOR RCVD [8]
VECTOR RCVD [4]
VECTOR RCVD [7]
VECTOR RCVD [4]
VECTOR RCVD [8]

Second Largest

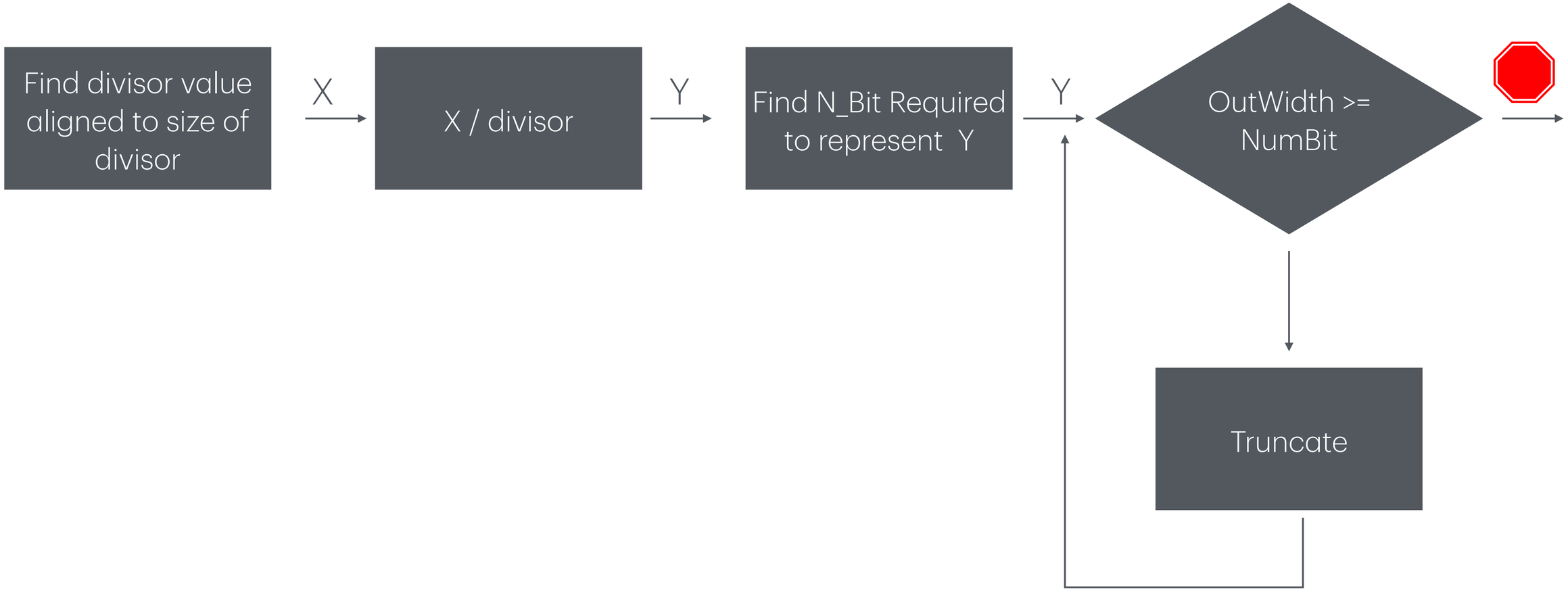




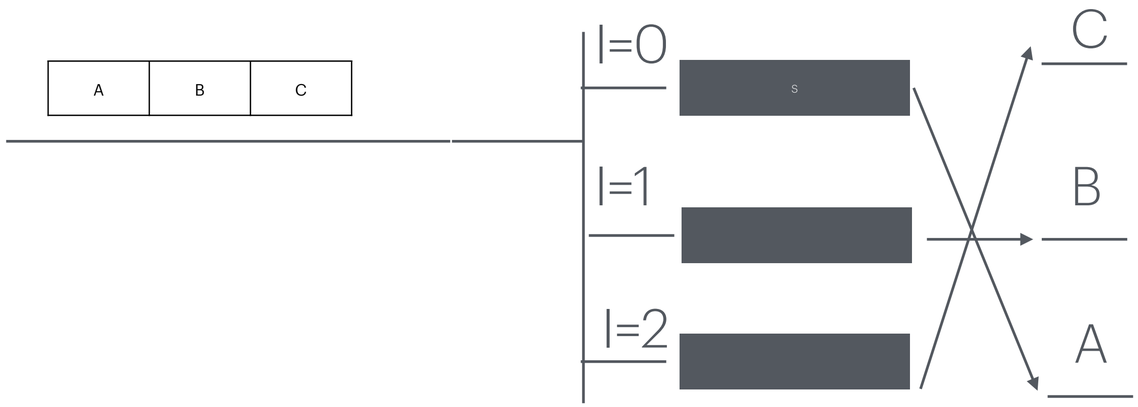
Count	0	1	2	3	4	
Data_In	D0	D1	D2	D3	D4	
2nd Largest	0	0	2	2	2	3

-, **2** 3, **2** 3, **2** 3, **2** 7, **3**

Rounded Division

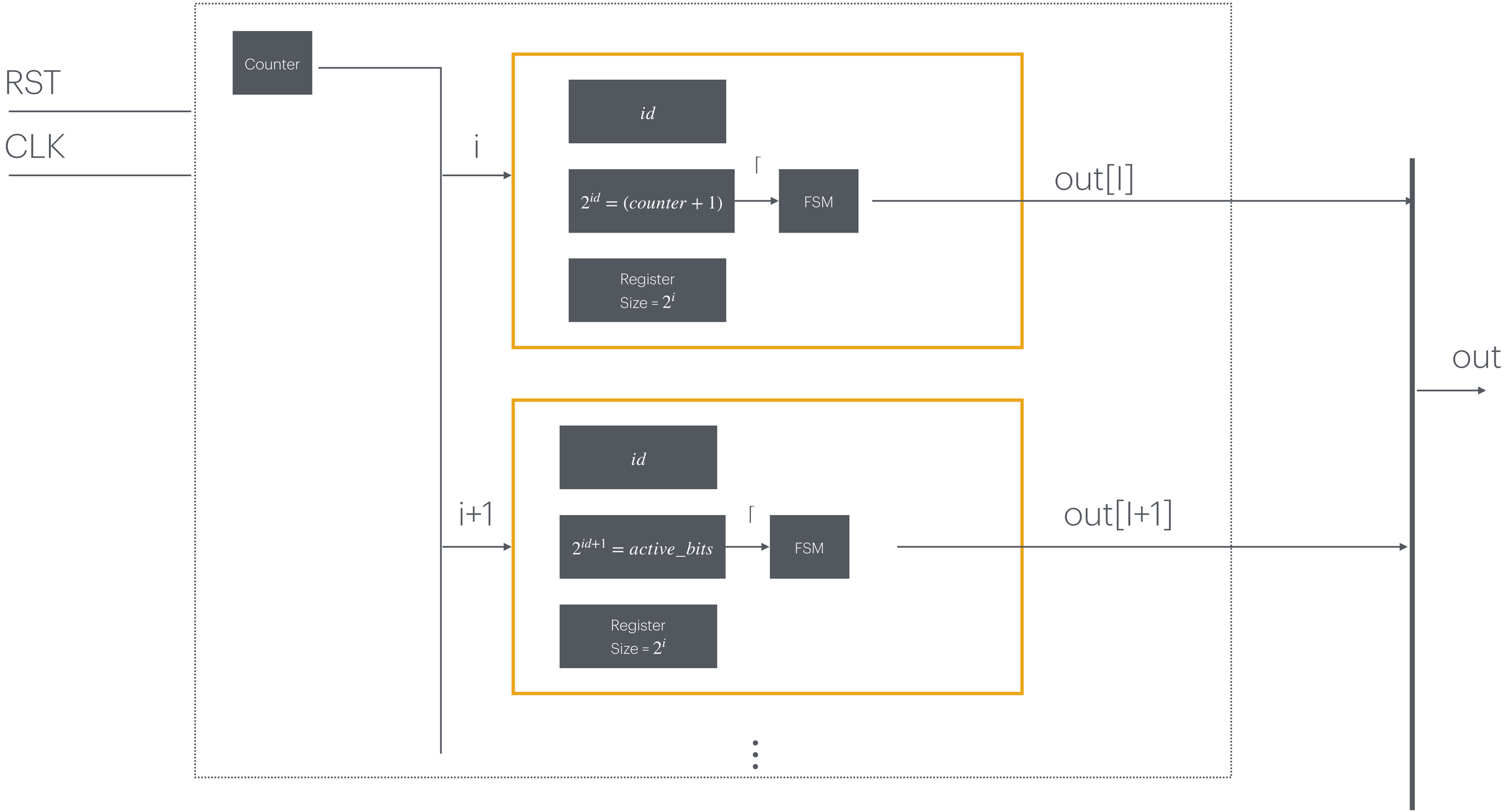


Reverse Bits



Generate Logic Blocks

Gray code


RST
CLK
Counter
i
id
$2^{id} = (counter + 1)$
⌈
FSM
Register
Size = 2^i
out[I]
out
i+1
id
$2^{id+1} = active\_bits$
⌈
FSM
Register
Size = 2^i
out[I+1]

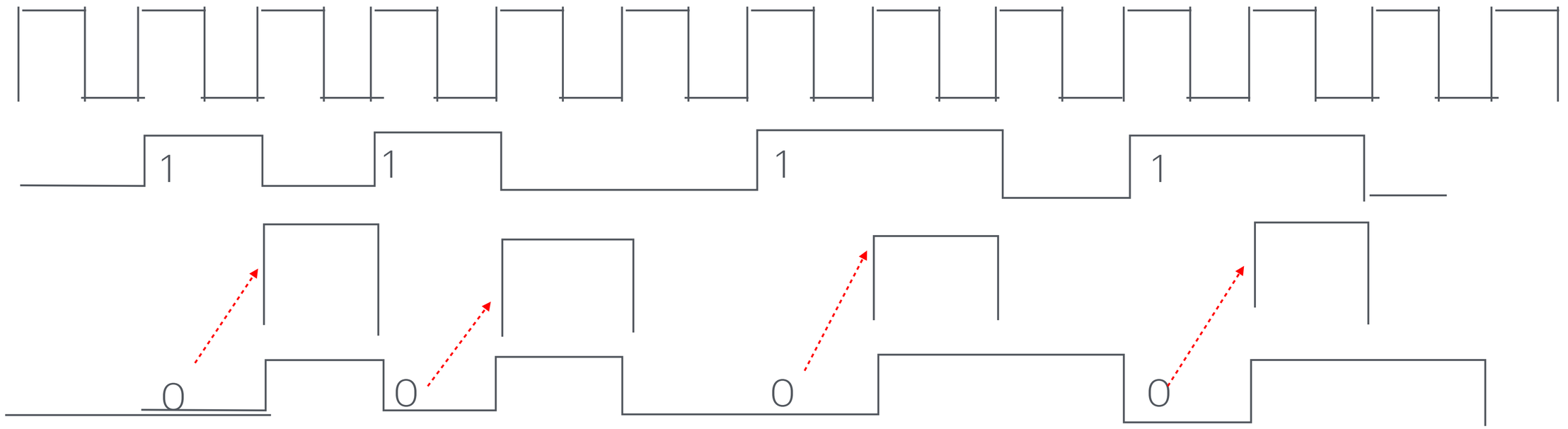
Gray code

Vertical Delay :)

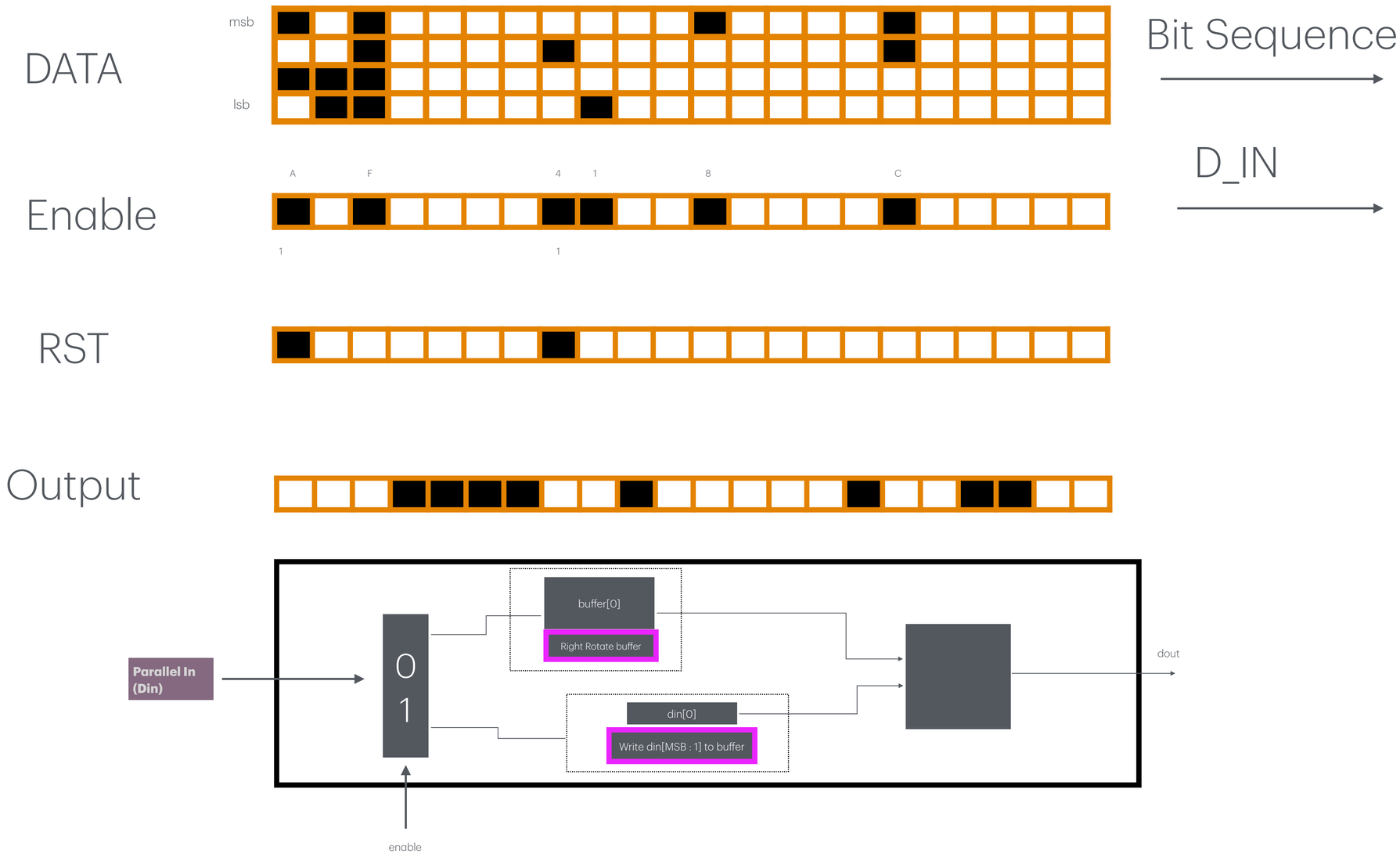
$2^3 = 8cycle$ $2^2 = 4cycle$ $2^1 = 2cycle$ $2^0 = 1cycle$

0	0	0	0
0	0	0	1
0	0	1	1
0	0	1	0
0	1	1	0

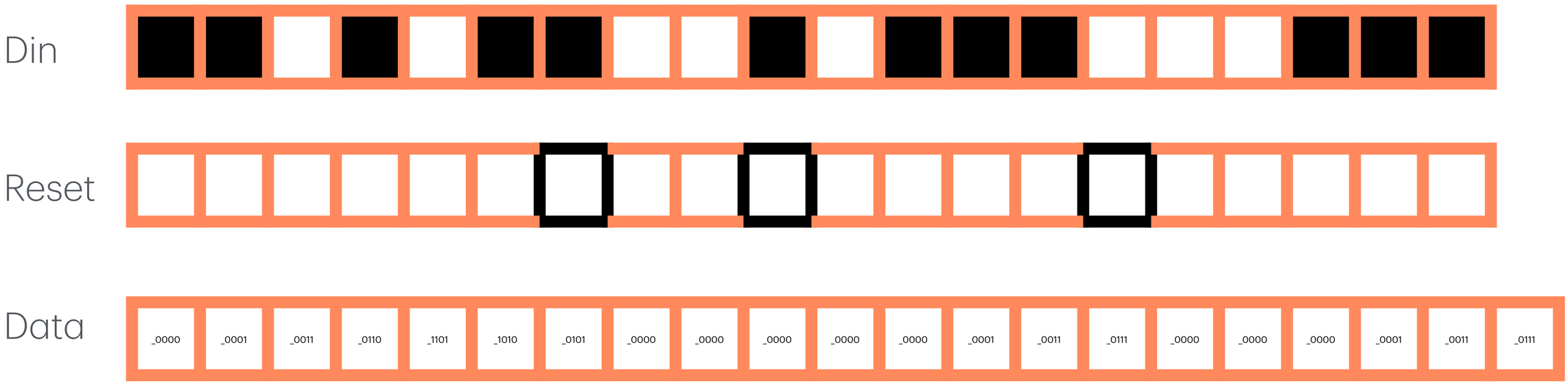
Egde Detector

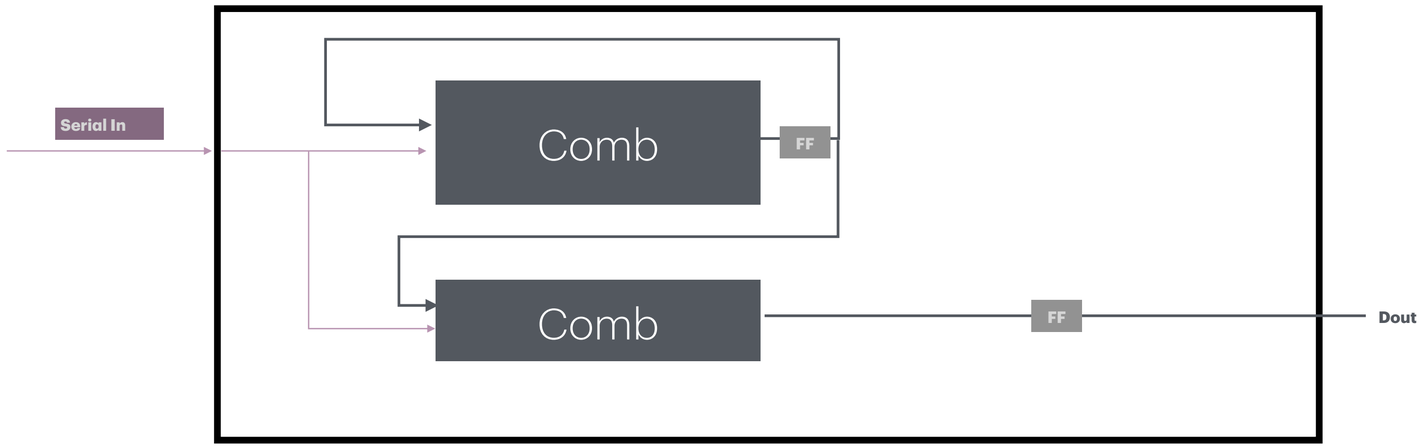


Parralel In -Serial Out

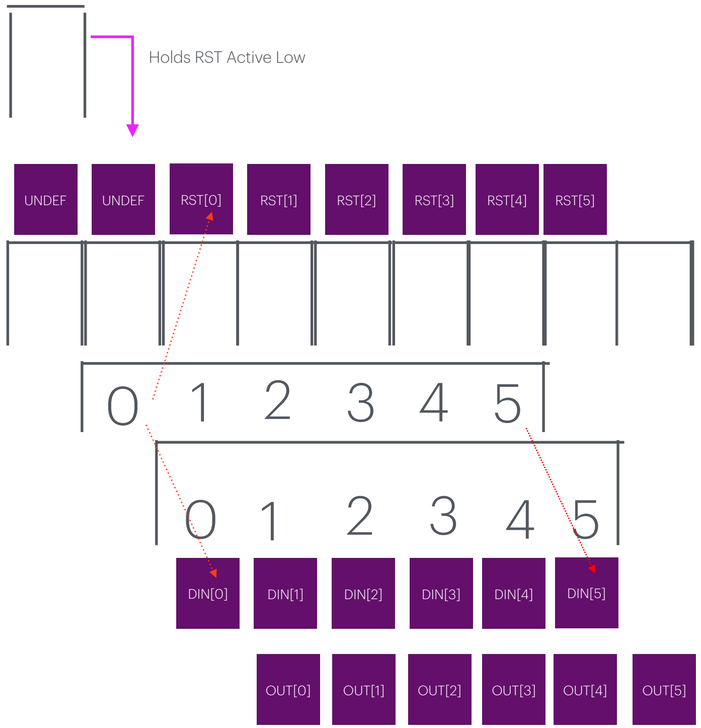


Serial to Parallel

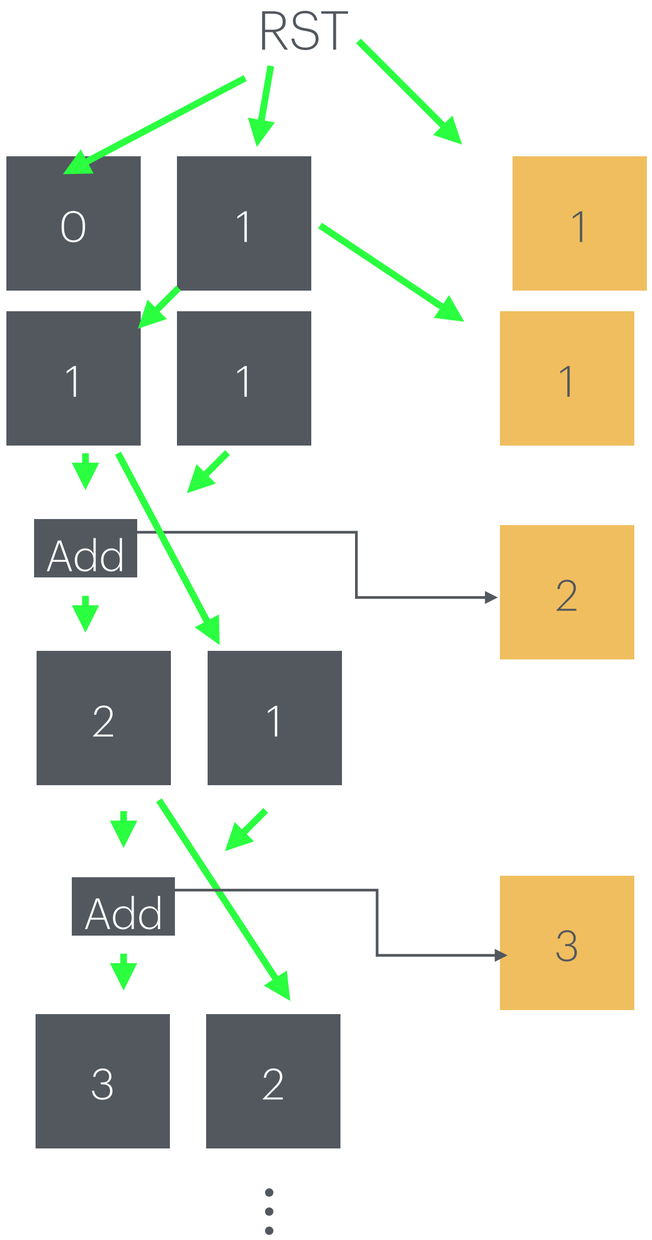




Serial to Parallel (Simulation Concept)

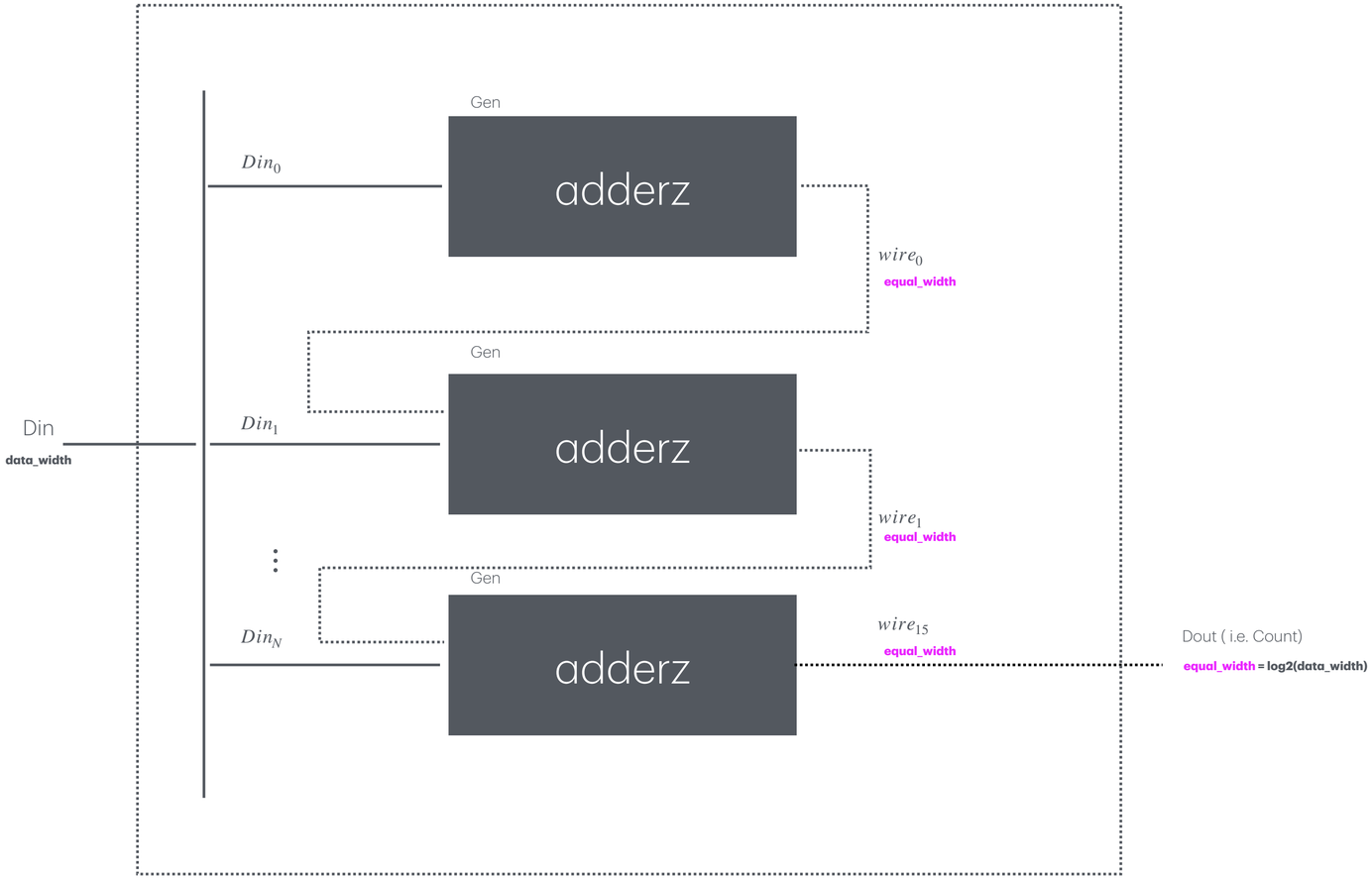


Fibonacci



Count Ones

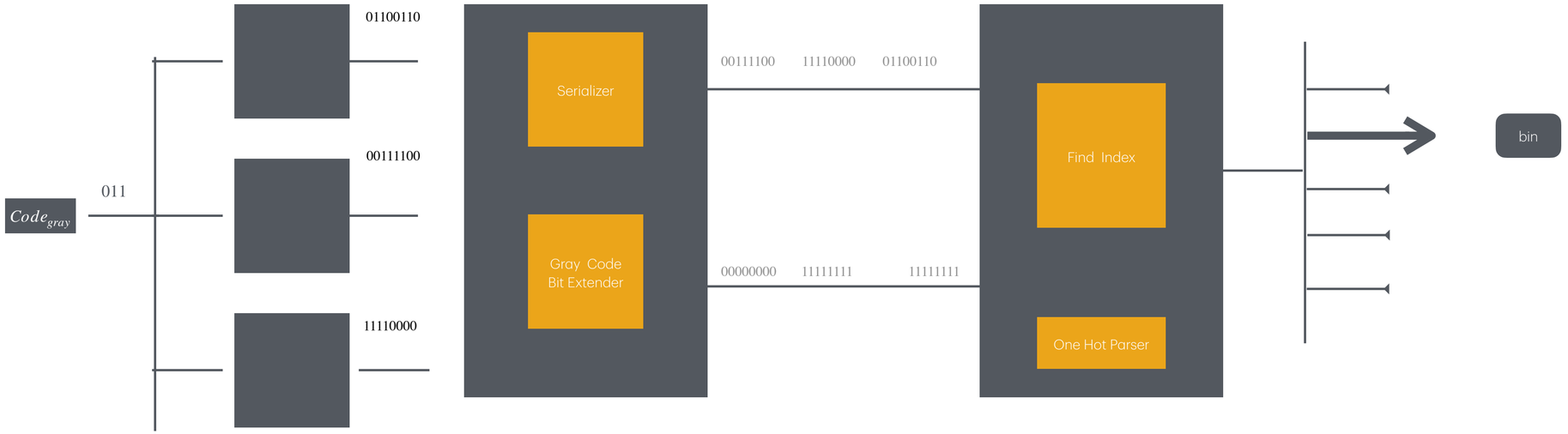
Architecture Similar to Linked List



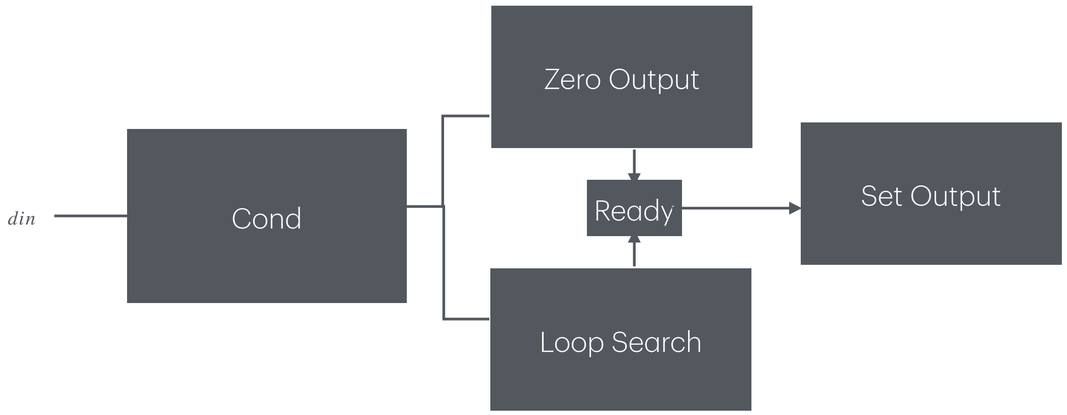
Count Ones

```
[2025-10-21 23:50:16 UTC] iverilog '-Wall' '-g2012' design.sv testbench.sv  && unbuffer vvp a.out
index -  0   input -     3   n_ones -  2
index -  1   input -     5   n_ones -  2
index -  2   input -     8   n_ones -  1
testbench.sv:44: $finish called at 9 (1s)
Done
```

Gray Code to Binary (Width = 3)



Trailing Ones

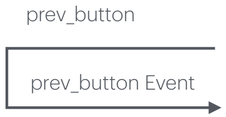


StopWatch Timer

TICK	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
START																								
RESET																								
STOP																								
COUNT	0	0	0	1	2	0	0	0	0	0	0	1	2	0	0	1	1	1	1	1	1	2	3	4

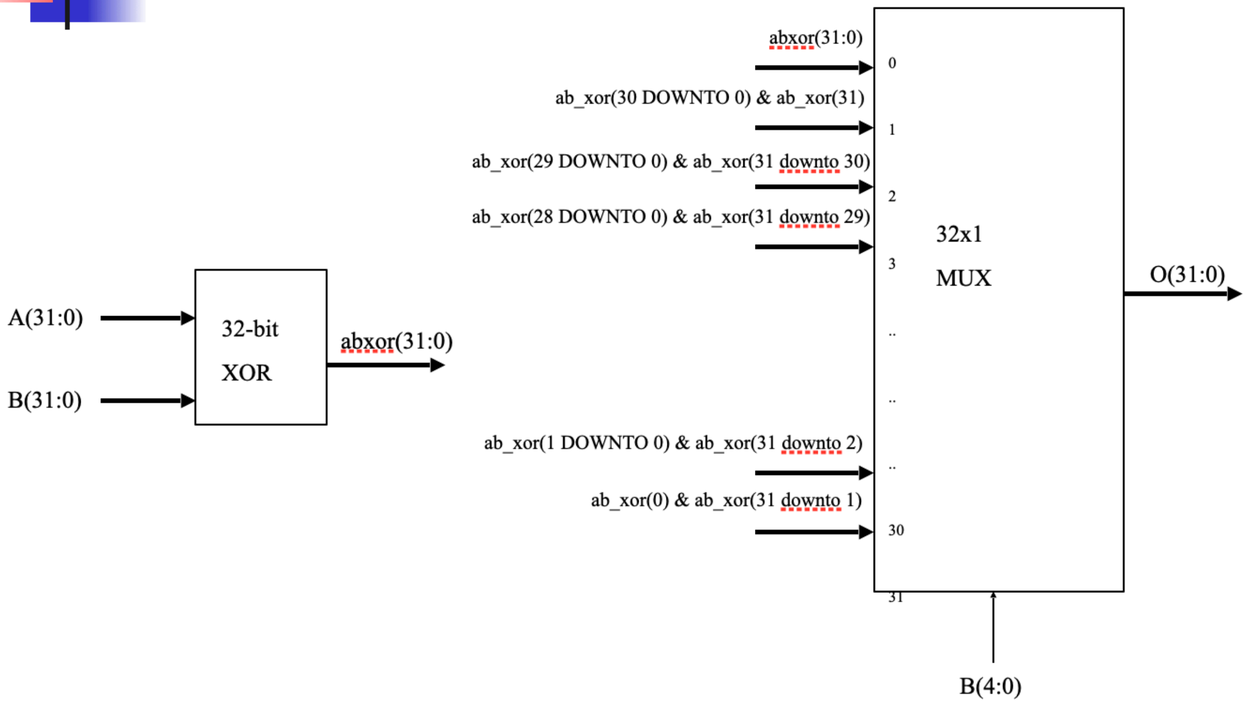
Testbench **monitors rdy** at this time stamp

StopWatch Timer



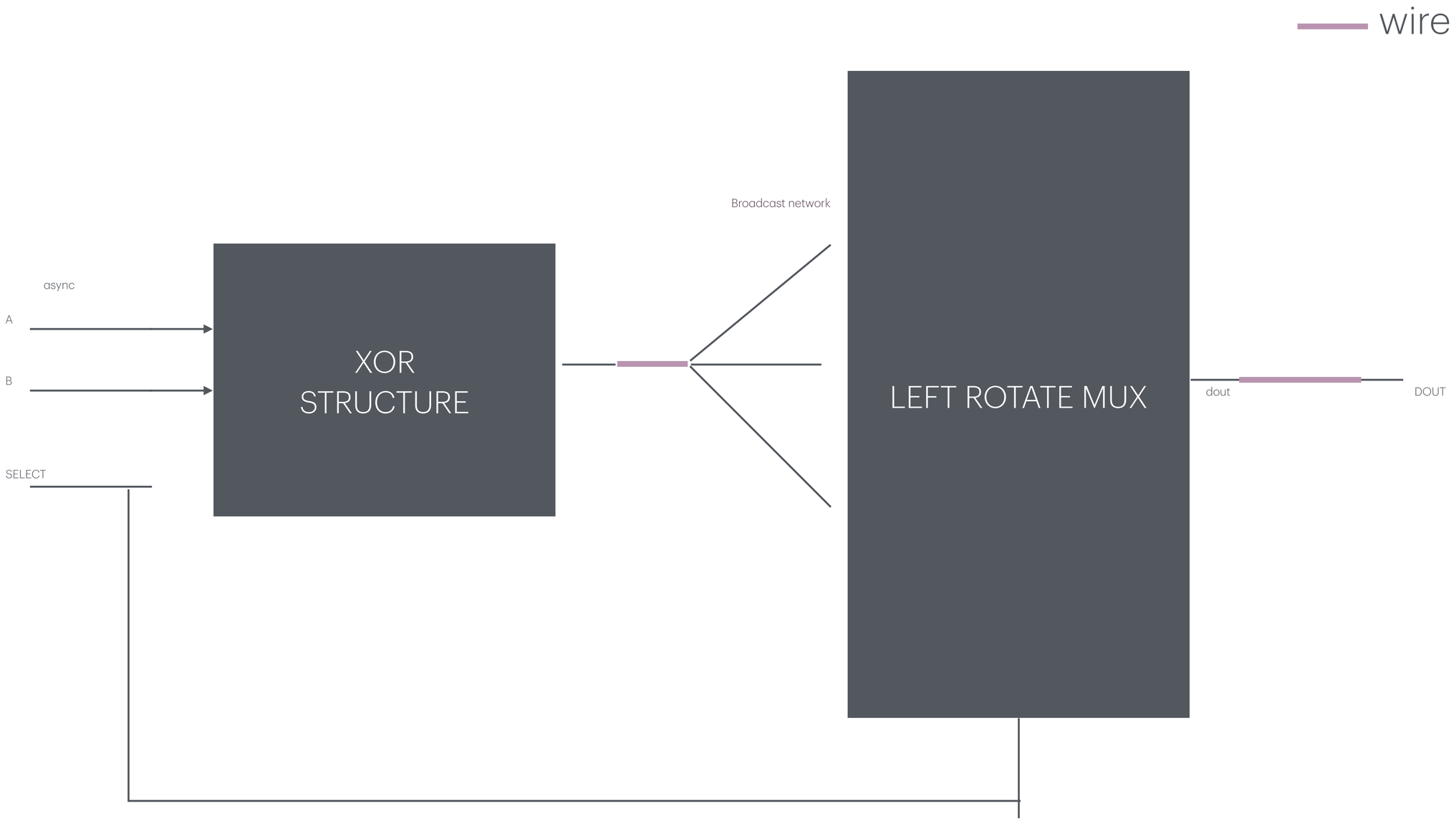

```
[2025-10-23 19:15:00 UTC] iverilog '-Wall' '-g2012' design.sv testbench.sv  && unbuffer vvp a.out
[  0] Button Press: reset[0] start[0] stop[0]  return -     0
[  1] Button Press: reset[0] start[0] stop[0]  return -     0
[  2] Button Press: reset[0] start[1] stop[0]  return -     0
[  3] Button Press: reset[0] start[0] stop[0]  return -     1
[  4] Button Press: reset[1] start[0] stop[0]  return -     2
[  5] Button Press: reset[0] start[0] stop[0]  return -     0
[  6] Button Press: reset[0] start[0] stop[0]  return -     0
[  7] Button Press: reset[0] start[1] stop[1]  return -     0
[  8] Button Press: reset[0] start[0] stop[0]  return -     0
[  9] Button Press: reset[0] start[0] stop[0]  return -     0
[ 10] Button Press: reset[0] start[1] stop[0]  return -     0
[ 11] Button Press: reset[0] start[0] stop[0]  return -     1
[ 12] Button Press: reset[1] start[1] stop[1]  return -     2
[ 13] Button Press: reset[0] start[0] stop[0]  return -     0
[ 14] Button Press: reset[0] start[1] stop[0]  return -     0
[ 15] Button Press: reset[0] start[0] stop[1]  return -     1
[ 16] Button Press: reset[0] start[0] stop[0]  return -     1
[ 17] Button Press: reset[0] start[0] stop[0]  return -     1
[ 18] Button Press: reset[0] start[0] stop[1]  return -     1
[ 19] Button Press: reset[0] start[0] stop[0]  return -     1
[ 20] Button Press: reset[0] start[1] stop[0]  return -     1
[ 21] Button Press: reset[0] start[0] stop[0]  return -     2
[ 22] Button Press: reset[0] start[0] stop[0]  return -     3
[ 23] Button Press: reset[0] start[0] stop[0]  return -     4
testbench.sv:136: $finish called at 114000 (1ps)
Done
```

O=A <<<B (Synthesis)

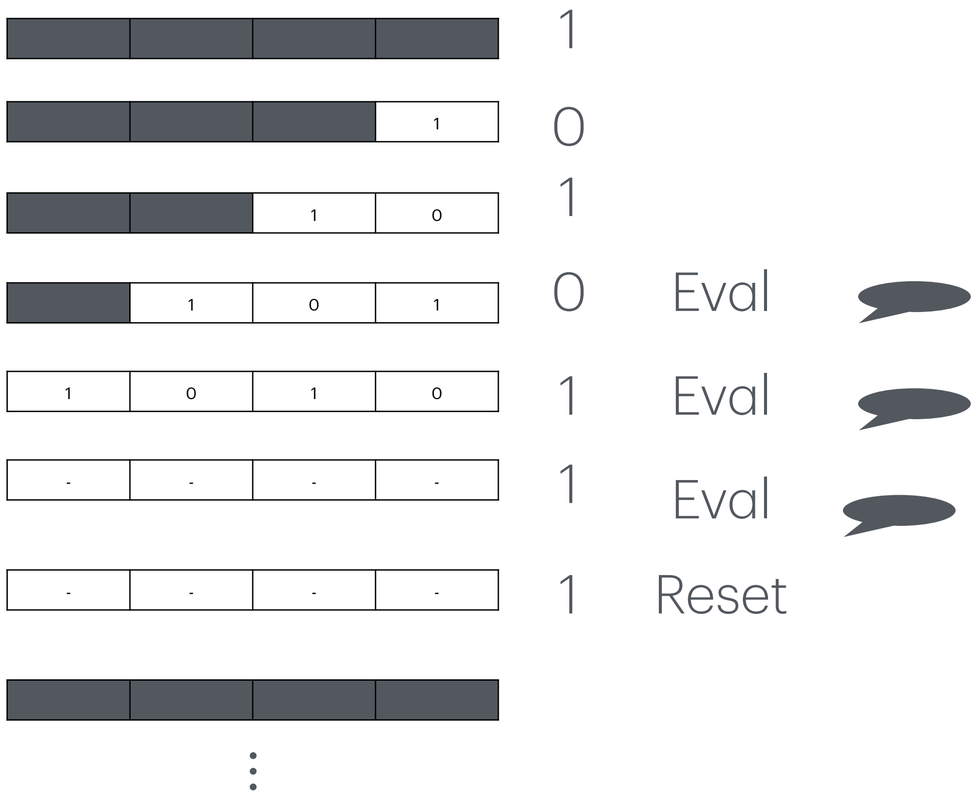


Circuit from OLD grad school slides :). Might as well build it in SV

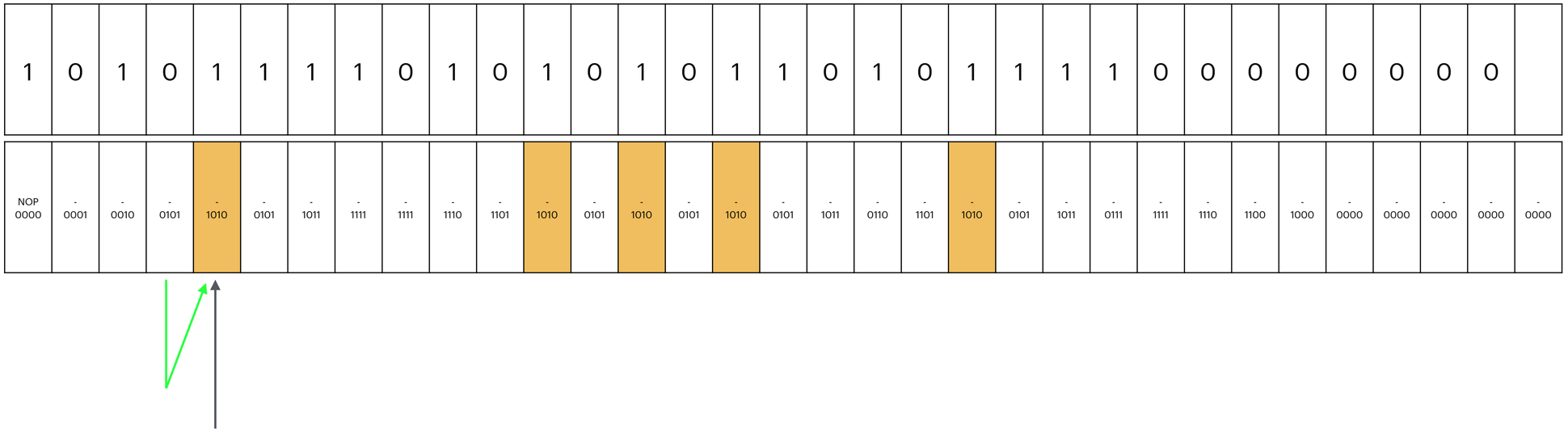
Random Circuit 1



Sequence Detector



Sequence Detector

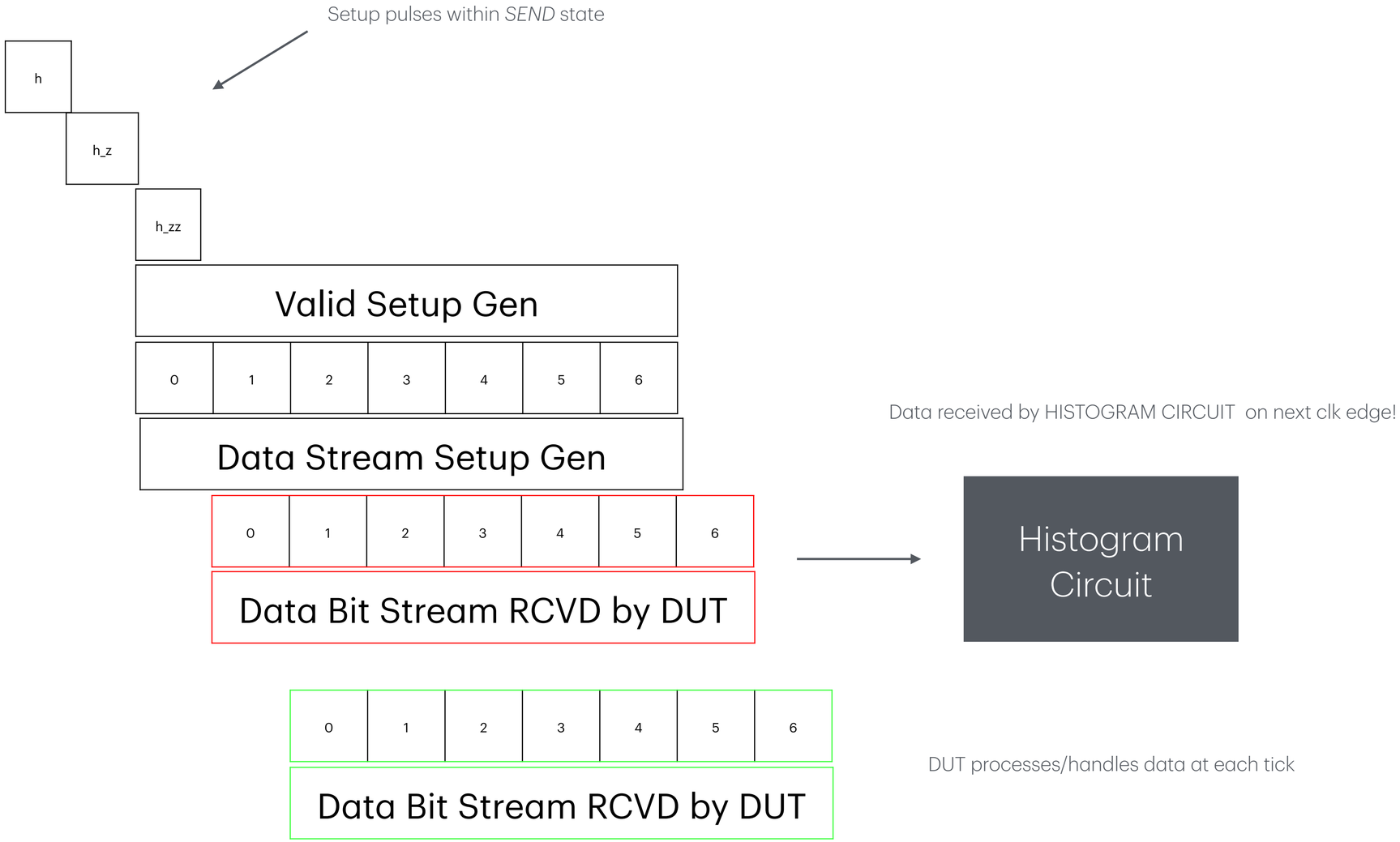


FIFO FULL

Evaluations of sequence are valid

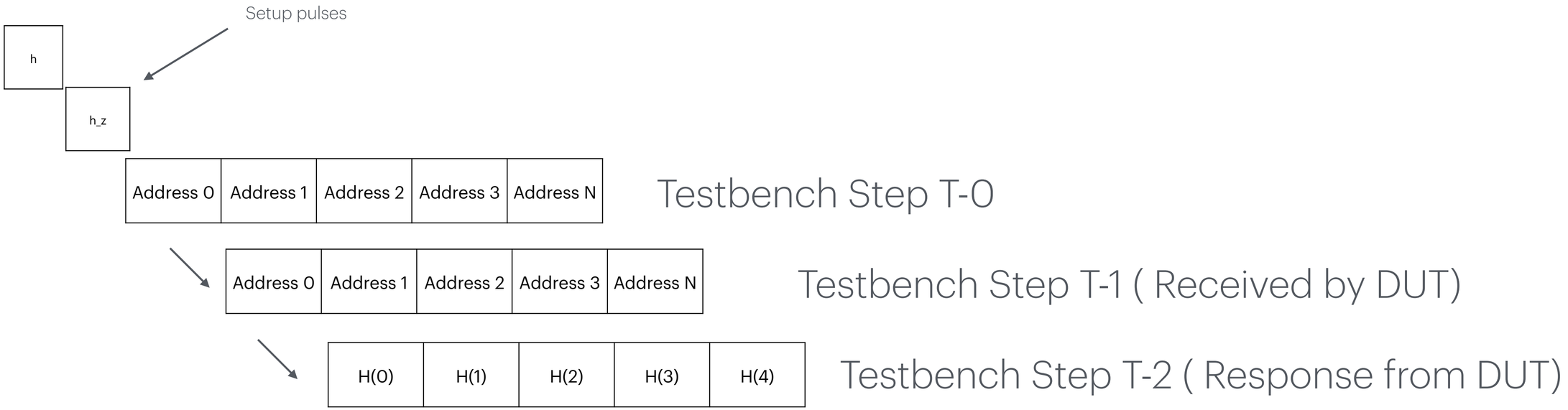
Histo Amazon

Send Mechanism

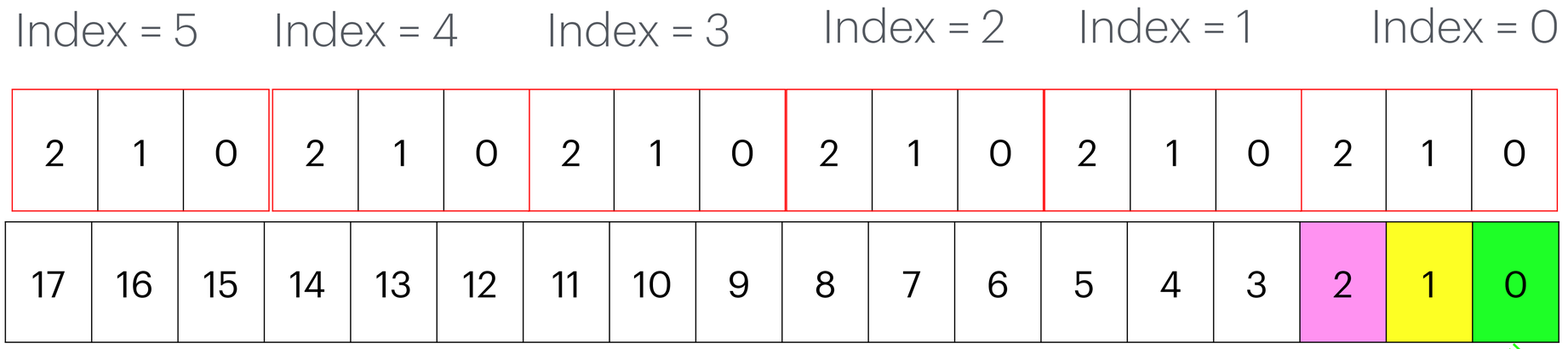


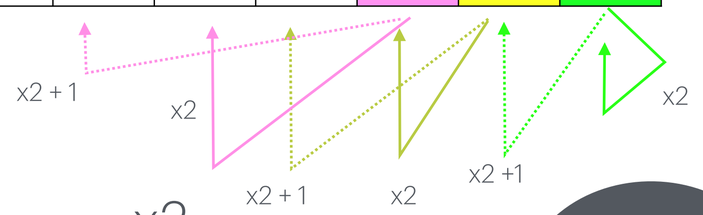
Histo Amazon

Receive Mechanism (Test Address)

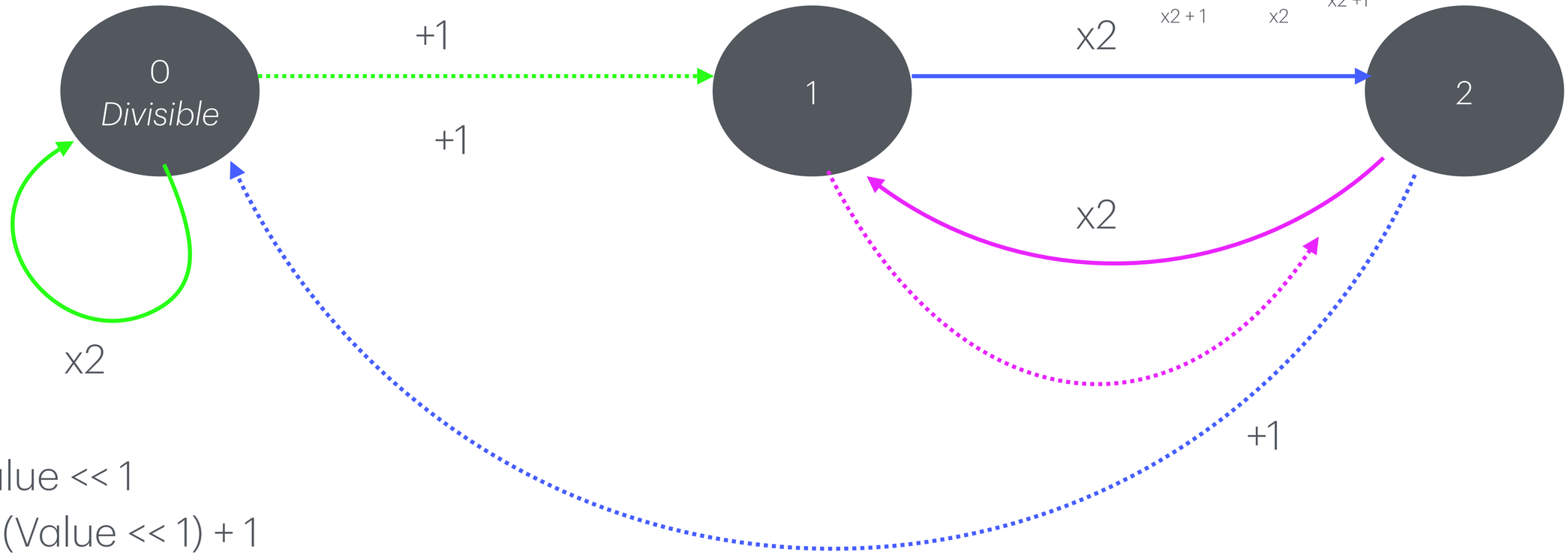


Divisible By Three





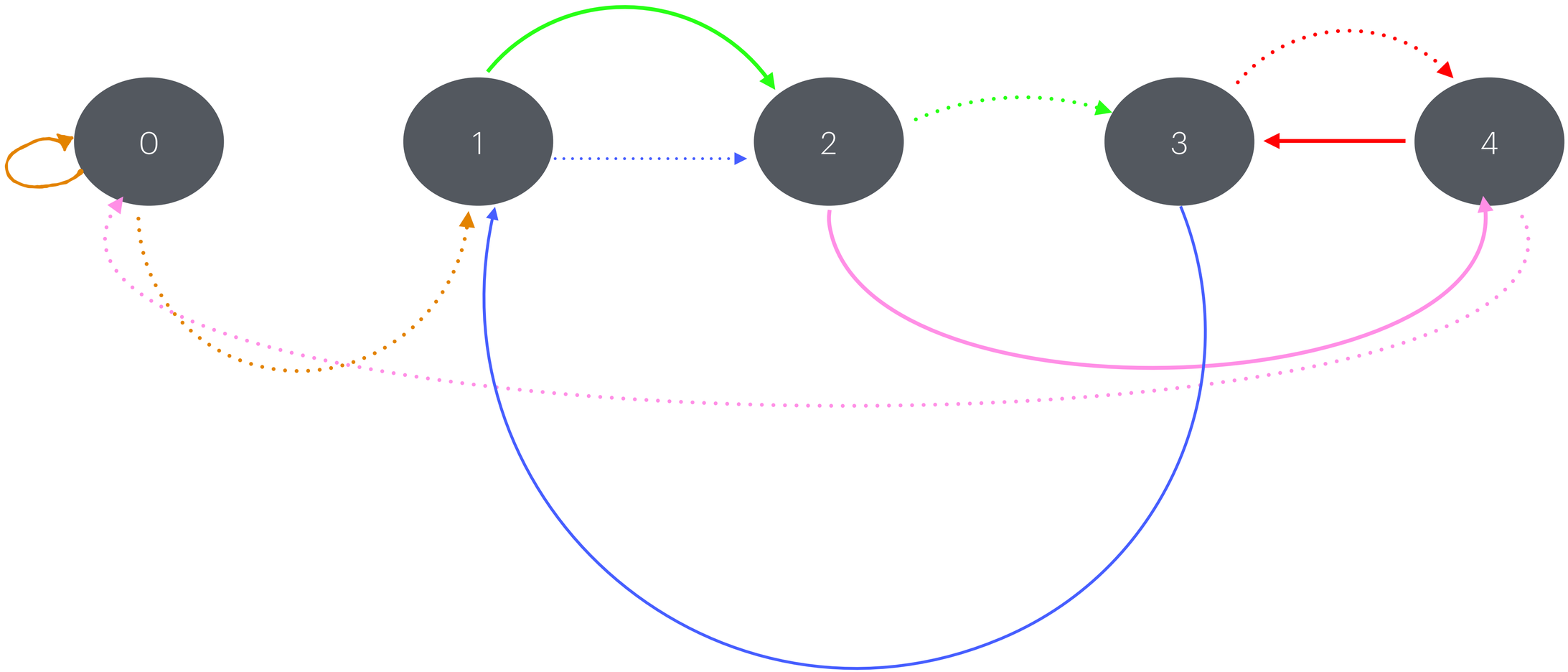
State Flow



x2 = Value << 1

x2 + 1= (Value << 1) + 1

Divisible By Five



Palindrome

Odd Data Width

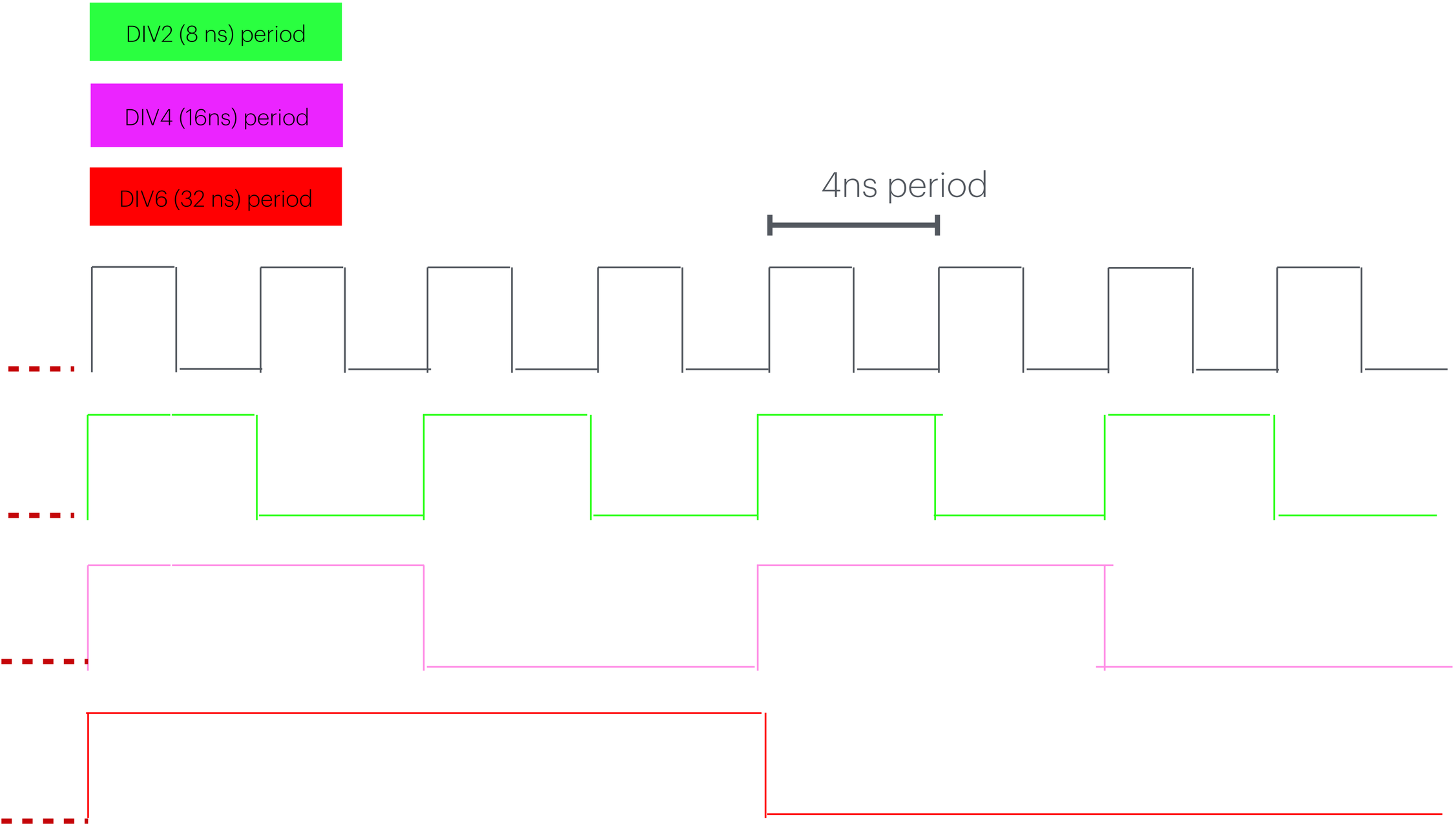
0	1	0	1	0

Half_Size_Floored = 2

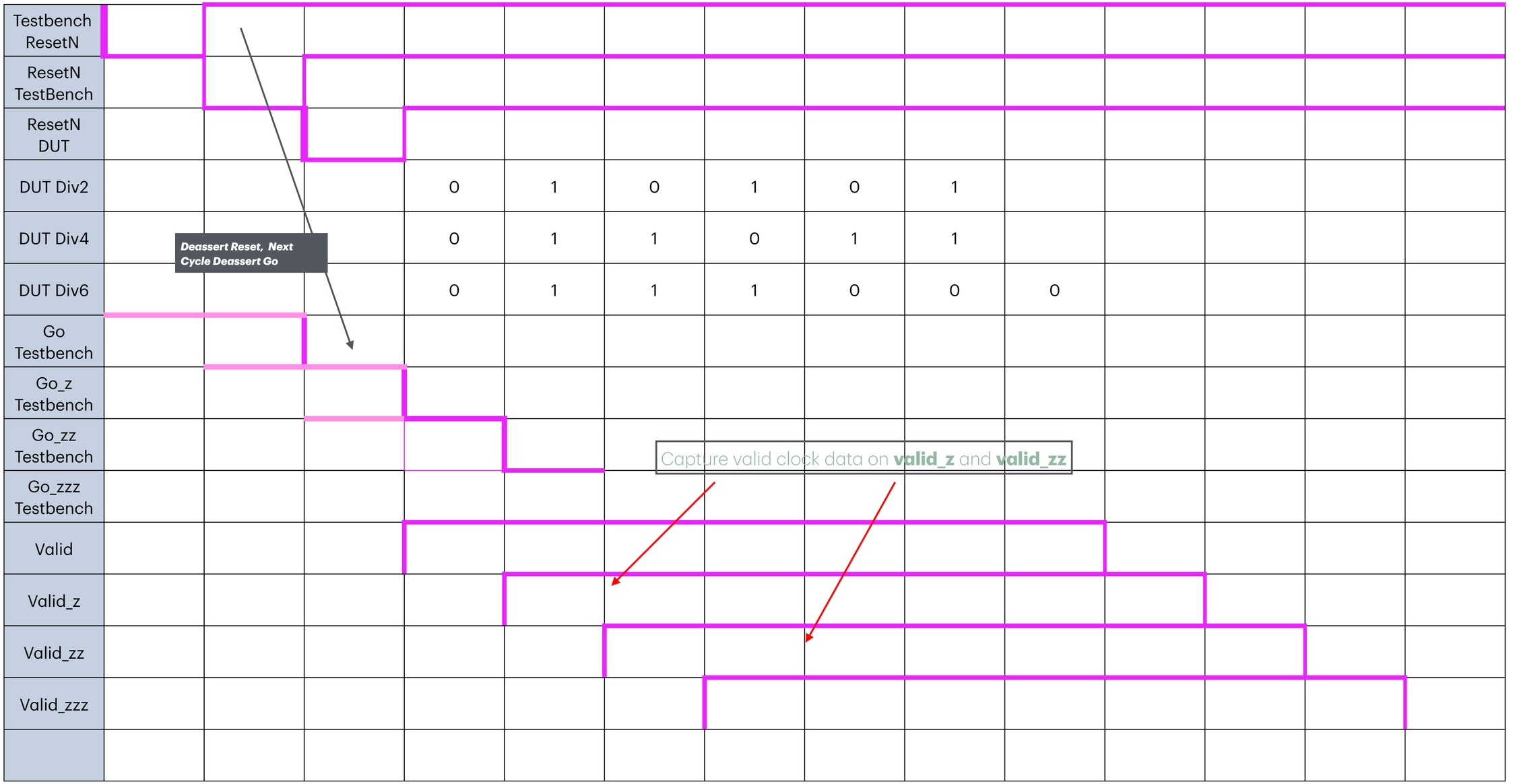
Even Data Width

0	1	1	1

Divide-By-Events



Divide-By-Events Timing



Testbench Log

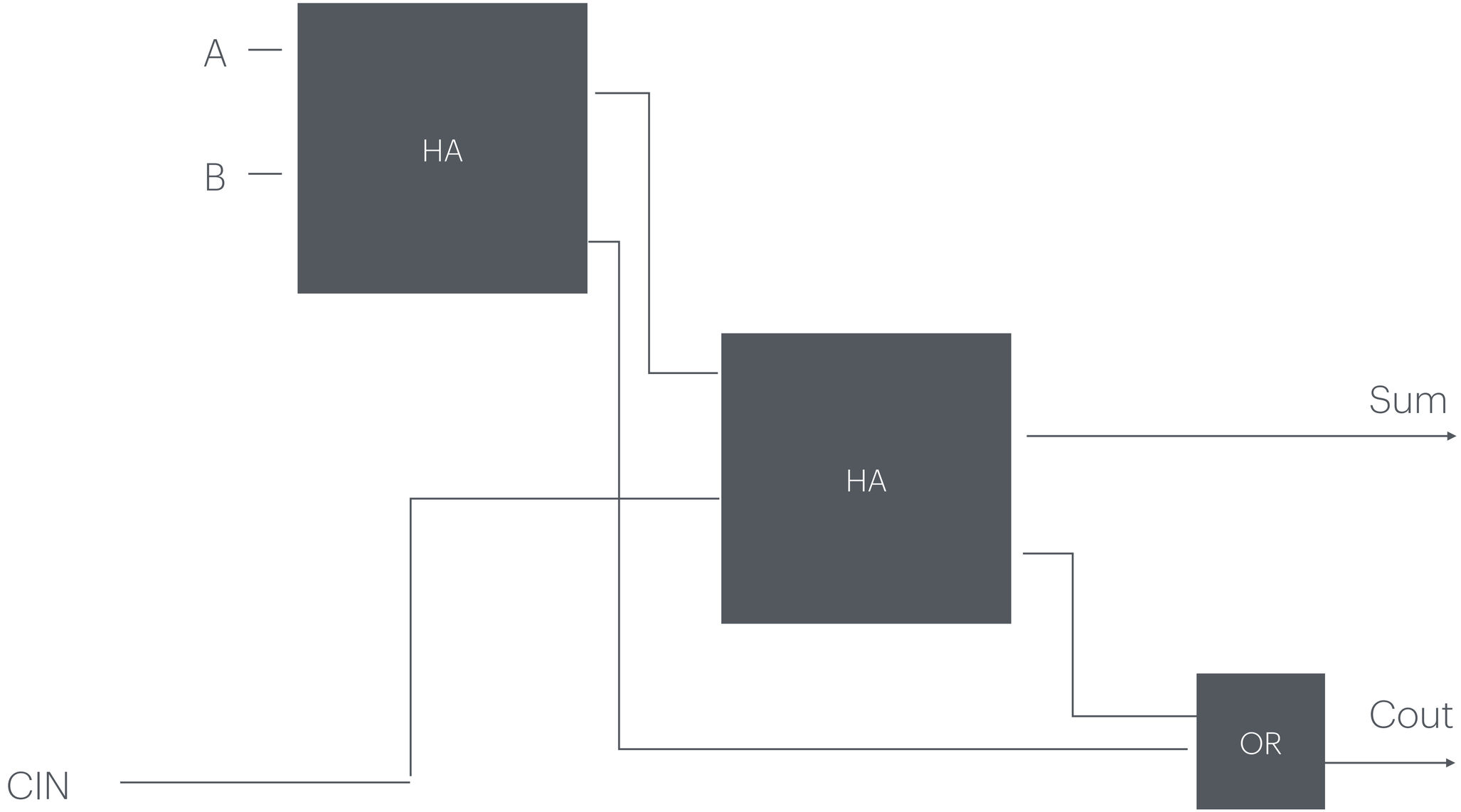
```
TARGETS [11011]  [11110]
Input 00001 Response 0
Input 00010 Response 0
Input 00101 Response 0
Input 01011 Response 0
Input 10111 Response 0
Input 01111 Response 0
Input 11111 Response 0
Input 11110 Response 1
Input 11101 Response 0
Input 11011 Response 0
testbench.sv:132: $finish called at 33 (1s)
Done
```

12	11	10	9	8	7	6	5	4	3	2	1	0	Tick
2	1	0	4	3	2	1	0	0	4	2	1	0	Fizz Mod
0	2	1	0	2	1	0	2	1	0	2	1	0	Buzz Mod

FizzBuzz

```
[2025-10-27 23:34:07 UTC] iverilog '-Wall' '-g2012' design.sv testbench.sv  && unbuffer vvp a.out
Time  0  fiss - 1. buzz - 1. fizzbuzz  1
Time  1  fiss - 0. buzz - 0. fizzbuzz  0
Time  2  fiss - 0. buzz - 0. fizzbuzz  0
Time  3  fiss - 1. buzz - 0. fizzbuzz  0
Time  4  fiss - 0. buzz - 0. fizzbuzz  0
Time  5  fiss - 0. buzz - 1. fizzbuzz  0
Time  6  fiss - 1. buzz - 0. fizzbuzz  0
Time  7  fiss - 0. buzz - 0. fizzbuzz  0
Time  8  fiss - 0. buzz - 0. fizzbuzz  0
Time  9  fiss - 1. buzz - 0. fizzbuzz  0
Time 10  fiss - 0. buzz - 1. fizzbuzz  0
Time 11  fiss - 0. buzz - 0. fizzbuzz  0
Time 12  fiss - 1. buzz - 0. fizzbuzz  0
Time 13  fiss - 0. buzz - 0. fizzbuzz  0
Time 14  fiss - 0. buzz - 0. fizzbuzz  0
Time 15  fiss - 1. buzz - 1. fizzbuzz  1
Time 16  fiss - 0. buzz - 0. fizzbuzz  0
Time 17  fiss - 0. buzz - 0. fizzbuzz  0
Time 18  fiss - 1. buzz - 0. fizzbuzz  0
Time 19  fiss - 0. buzz - 0. fizzbuzz  0
Time 20  fiss - 0. buzz - 1. fizzbuzz  0
Time 21  fiss - 1. buzz - 0. fizzbuzz  0
Time 22  fiss - 0. buzz - 0. fizzbuzz  0
Time 23  fiss - 0. buzz - 0. fizzbuzz  0
Time 24  fiss - 1. buzz - 0. fizzbuzz  0
Time 25  fiss - 0. buzz - 1. fizzbuzz  0
Time 26  fiss - 0. buzz - 0. fizzbuzz  0
Time 27  fiss - 1. buzz - 0. fizzbuzz  0
Time 28  fiss - 0. buzz - 0. fizzbuzz  0
Time 29  fiss - 0. buzz - 0. fizzbuzz  0
testbench.sv:97: $finish called at 67 (1s)
Done
```

Full Adder



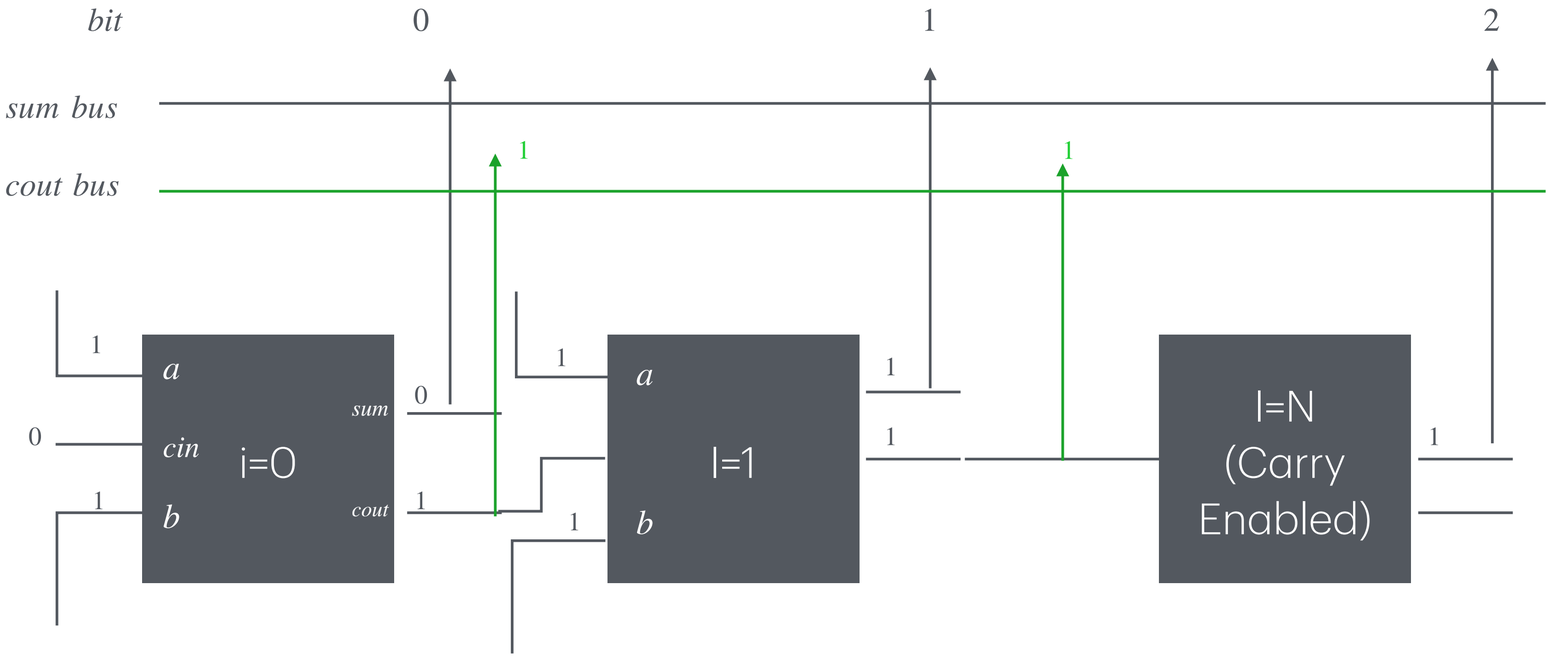
Full Adder

```
[2025-10-28 03:53:35 UTC] iverilog '-Wall' '-g2012' design.sv testbench.sv  && unbuffer vvp a.out
a - 0  b - 0. cin - 0 sum - 0  cout - 0
a - 0  b - 0. cin - 1 sum - 1  cout - 0
a - 0  b - 1. cin - 0 sum - 1  cout - 0
a - 0  b - 1. cin - 1 sum - 0  cout - 1
a - 1  b - 0. cin - 0 sum - 1  cout - 0
a - 1  b - 0. cin - 1 sum - 0  cout - 1
a - 1  b - 1. cin - 0 sum - 0  cout - 1
a - 1  b - 1. cin - 1 sum - 1  cout - 1
Done
```

Ripple Adder

A = 2b'11

B= 2b'11



1
1 1
1 1
0

1 1
1 1
1 1
1 0

1 1
1 1
1 1
1 1 0

Ripple Adder Testbench Logs

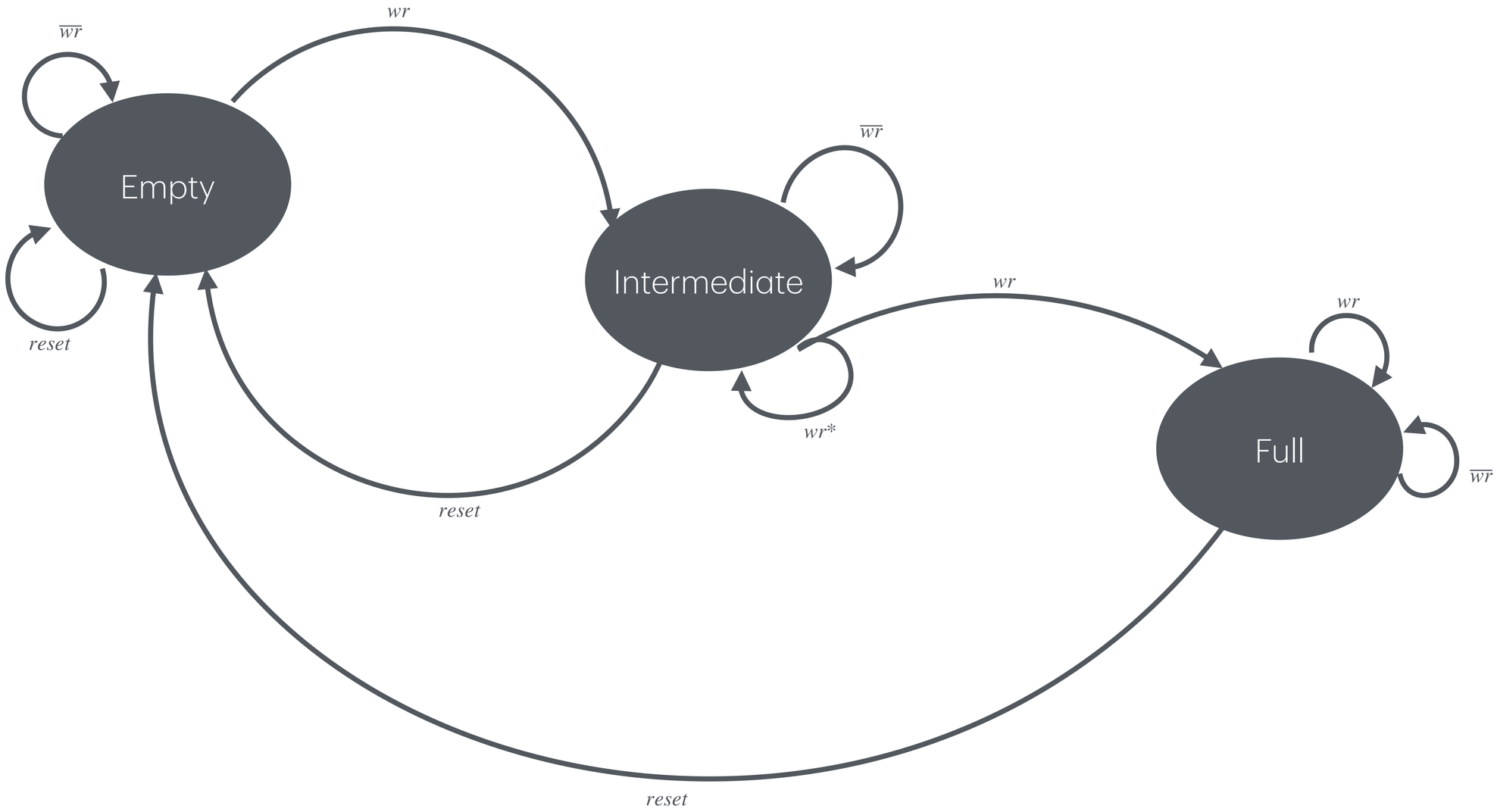
```
[2025-10-28 05:50:07 UTC] iverilog '-Wall' '-g2012' design.sv testbench.sv  && unbuffer vvp a.out
a -   3 b -   3  sum 000000110 cout 00000011
a -   7 b -  10  sum 000010001( 17) cout 00001110
a - 123 b - 189  sum 100111000(312) cout 11111111
Done
```

Time Step	0	1	2	3	4	5	6	7	8	9	10	11	
DIN	0	A	A	A									
ADDR		1	2	2	0	0	3	4	5	6	6	7	
WR		1		1									
RD		1	1		1		1	1	1	1	1	1	
RESETN													
DOUT						A	A	A	A	A	A	A	A
ERRR			1	1		1	0	1	1	1	1	1	1

Previous valid read persists on dout port

```
[2025-10-28 18:35:06 UTC] iverilog '-Wall' '-g2012' design.sv testbench.sv  && unbuffer vvp a.out
Time -    0 dout -   0  error - 0
Time -    1 dout -   0  error - 1
Time -    2 dout -   0  error - 1
Time -    3 dout -   0  error - 0
Time -    4 dout -   0  error - 1
Time -    5 dout -   0  error - 0
Time -    6 dout -   0  error - 1
Time -    7 dout -   0  error - 1
Time -    8 dout -   0  error - 1
Time -    9 dout -   0  error - 1
Time -   10 dout -   0  error - 1
Time -   11 dout -   0  error - 1
testbench.sv:185: $finish called at 35 (1s)
Done
```

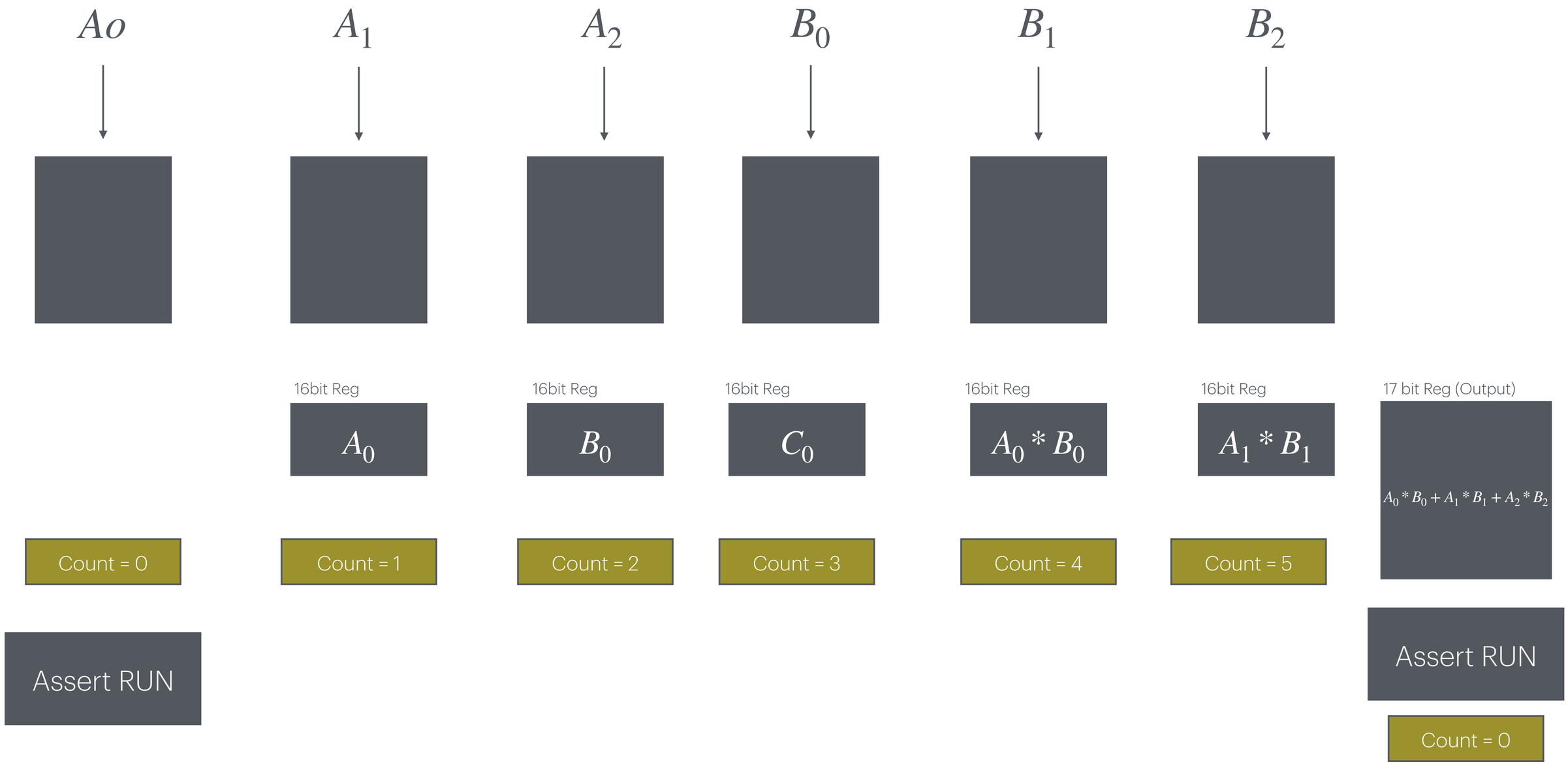
MULTI BIT FIFO



MULTI BIT FIFO

Time Step	0	1	2	3	4	5	6	
DIN	0	5	3	6	6	0	0	
WR	0	1	1	1	1	0	0	
DOUT	-	0	5	5	3	6	6	0
FULL	-	0	0	1	1	1	1	1
EMPTY	-	1	0	1	1	1	1	1

Dot Product


Ao
A_1
A_2
B_0
B_1
B_2
16bit Reg
A_0
16bit Reg
B_0
16bit Reg
C_0
16bit Reg
$A_0 * B_0$
16bit Reg
$A_1 * B_1$
17 bit Reg (Output)
$A_0 * B_0 + A_1 * B_1 + A_2 * B_2$
Count = 0
Count = 1
Count = 2
Count = 3
Count = 4
Count = 5
Assert RUN
Assert RUN
Count = 0

Dot Product

Rstn	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	
Din	16h0	16h0	16h0	16h0	16h0	16h1	16h2	16h3	16h4	16h5	16h6	16h7	16h8	16h9	16hA	16hB	16hC	16hd	
Dout	-	0	0	0	0	0	0	0	0	0	0	16h20	16h20	16h20	16h20	16h20	16h20	16h10A	16h10A
Run	-	1	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0
Internal Counter	-	-	-	0	0	0	1	2	3	4	5	0	1	2	3	4	5	0	

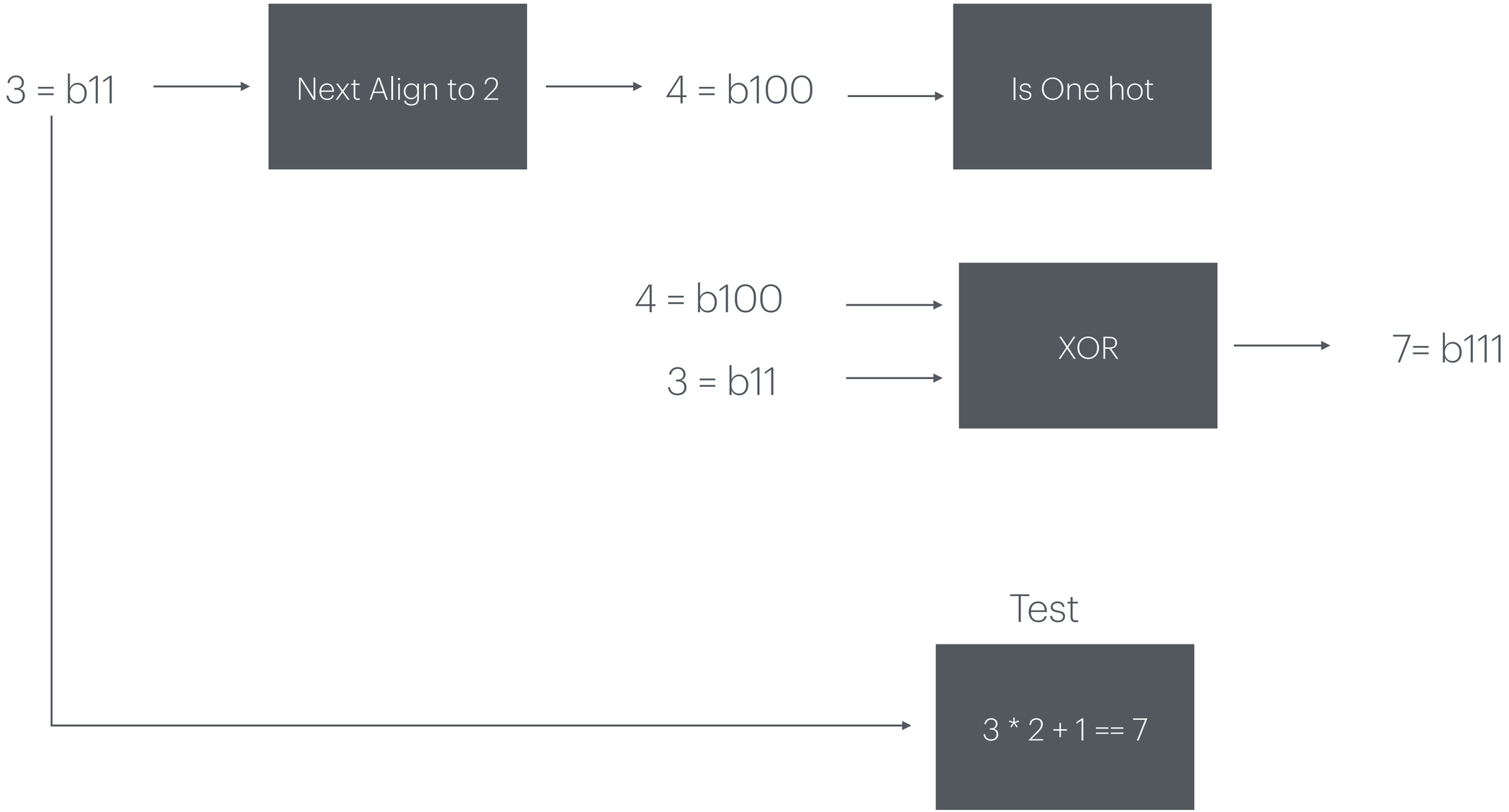
Counter zeroed

Counters running

Binary To Thermometer

0000_0000	0(255) + 1(1)
0000_0001	0(254) + 1(2)

Thermometer Code Detector



Thermometer Code Detector

```
[2025-10-29 19:17:40 UTC] iverilog '-Wall' '-g2012' design.sv testbench.sv  && unbuffer vvp a.out
code -     1  isThermometer - 1
code -     3  isThermometer - 1
code -     7  isThermometer - 1
code -    15  isThermometer - 1
code -    31  isThermometer - 1
code -    63  isThermometer - 1
code -   127  isThermometer - 1
code -   255  isThermometer - 1
code -   511  isThermometer - 1
code -  1023  isThermometer - 1
code -  2047  isThermometer - 1
code -  4095  isThermometer - 1
code -  8191  isThermometer - 1
code - 16383  isThermometer - 1
code - 32767  isThermometer - 1
code - 65535  isThermometer - 1
Done
```

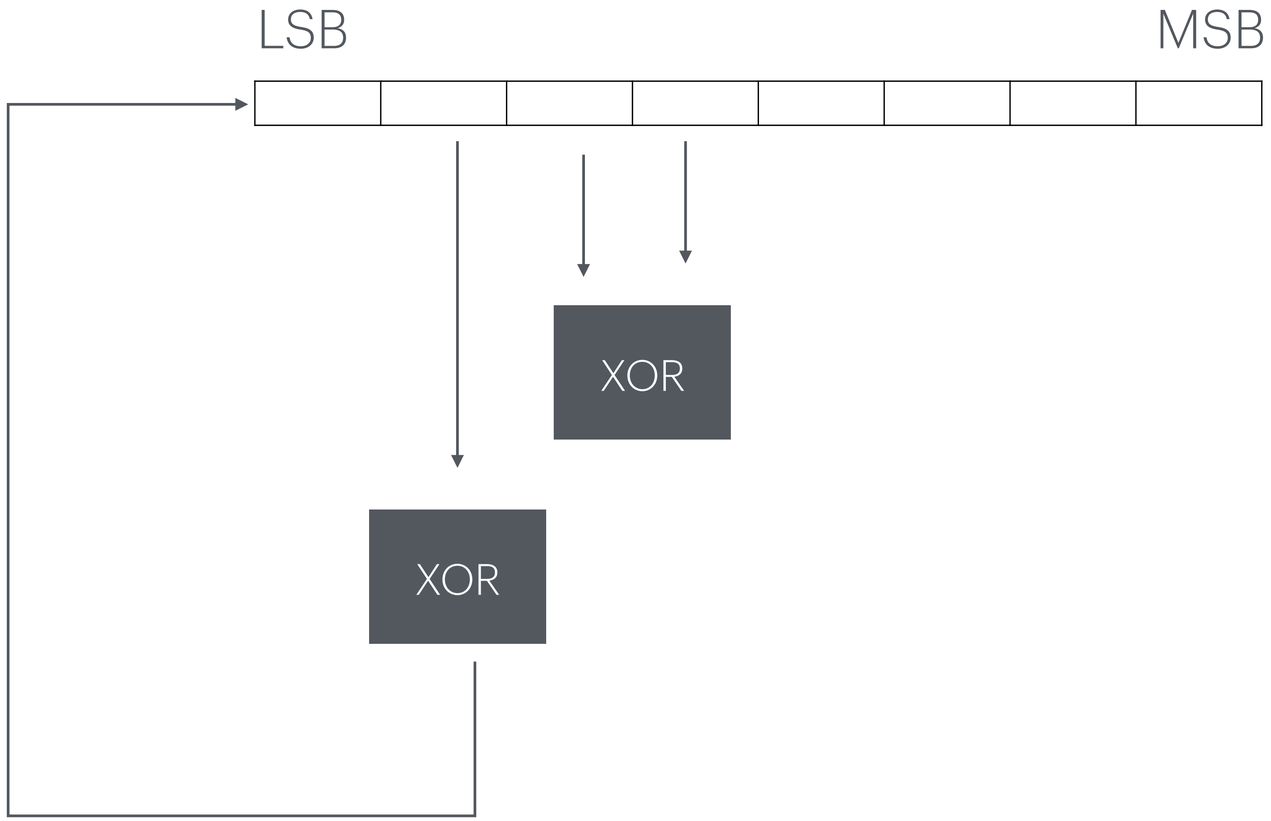
2 Read 1 Write Register File

Index	0	1	2	3	4	5	6	7	-
resetn	1	1	1	1	1	1	1	1	1
Din	0	30	100	20	0	40	29	0	10
Wad1	0	0	0	1	0	16	17	0	0
Rad1	0	0	1	0	1	0	0	16	0
Rad2	0	0	1	0	0	0	0	17	0
Wen1	0	0	0	1	0	1	1	0	0
Ren1	0	0	1	0	1	0	0	1	0
Ren2	0	0	1	0	0	0	0	1	0
Collision	0	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**
Dout1	0	**0**	**0**	**0**	**0**	**20**	**0**	**0**	**40**
Dout2	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**29**
Valid DUIT	1								
Valid Testbench Response	0	1							

2 Read 1 Write Register File

```
[2025-10-29 22:58:39 UTC] iverilog '-Wall' '-g2012' design.sv testbench.sv  && unbuffer vvp a.out
dout1-    0 dout2-    0 collision-0
dout1-    0 dout2-    0 collision-0
dout1-    0 dout2-    0 collision-0
dout1-    0 dout2-    0 collision-0
dout1-    0 dout2-    0 collision-0
dout1-   20 dout2-    0 collision-0
dout1-   20 dout2-    0 collision-0
dout1-   20 dout2-    0 collision-0
dout1-   20 dout2-    0 collision-0
dout1-   40 dout2-   29 collision-0
testbench.sv:199: $finish called at 23 (1s)
Done
```

8 Bit LFSR

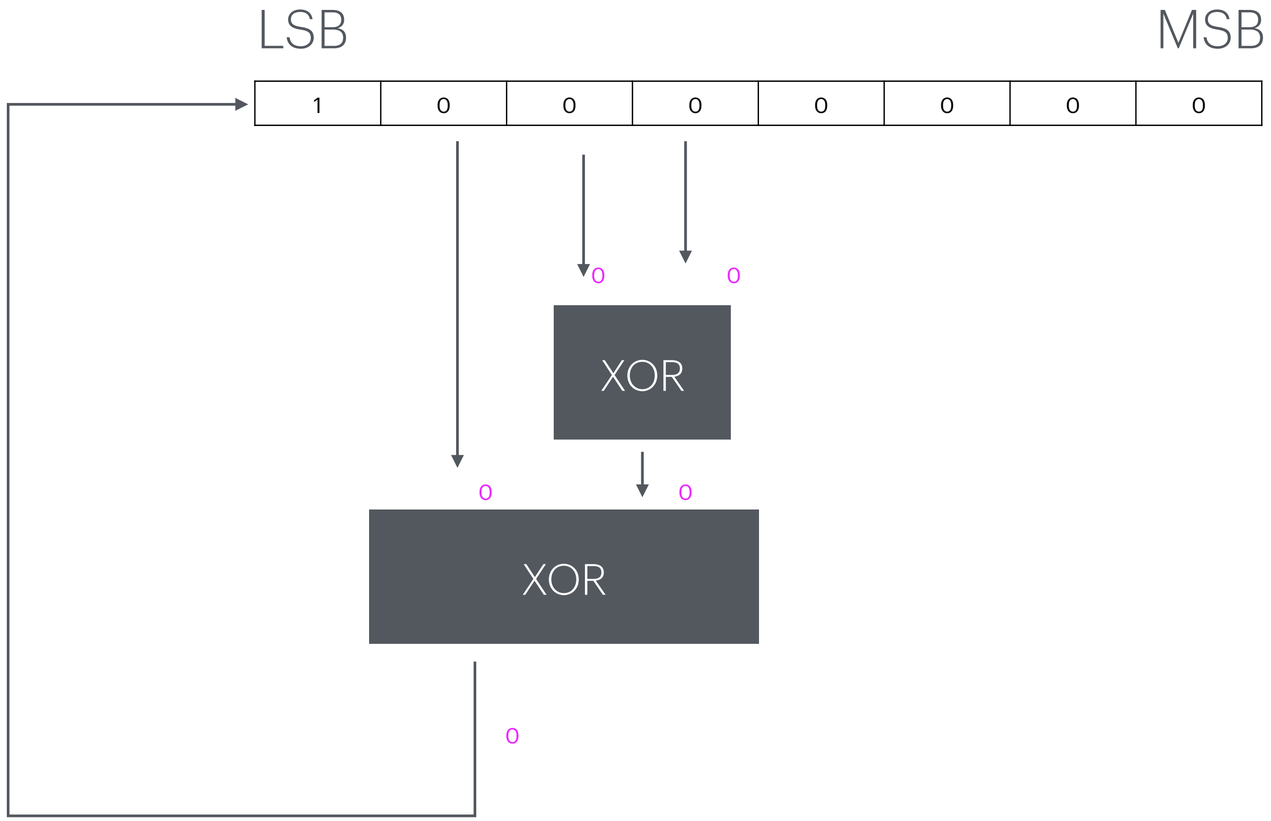


TAP = 16h_E

0b00001110

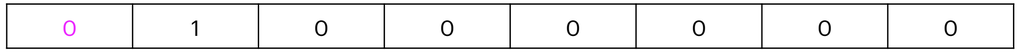
LSB

8 Bit LFSR SIMPLE EXAMPLE



TIME = 0 (RESET)

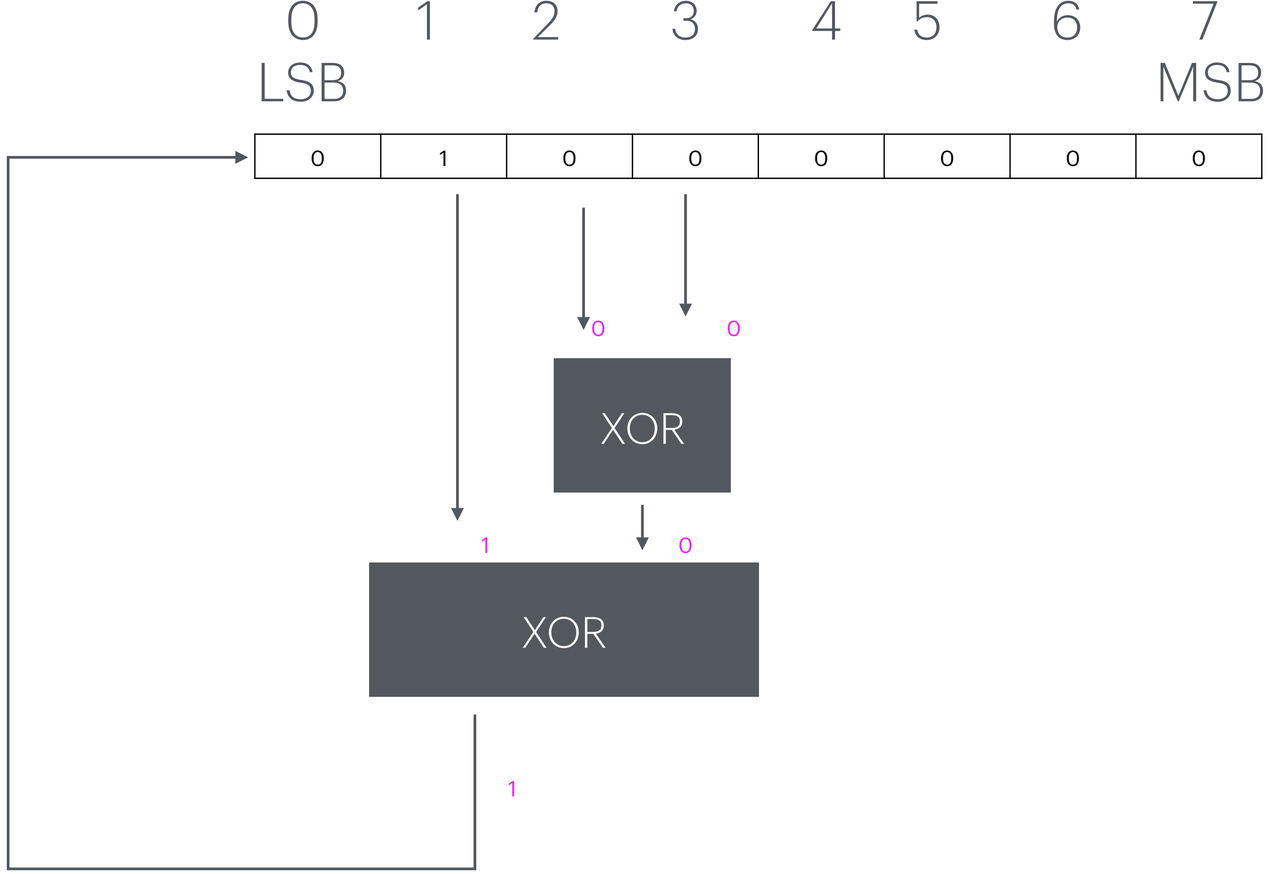
REGISTER VALUE = 1



TIME = 1

NEXT REGISTER VALUE = 2

8 Bit LFSR SIMPLE EXAMPLE



TIME = 1

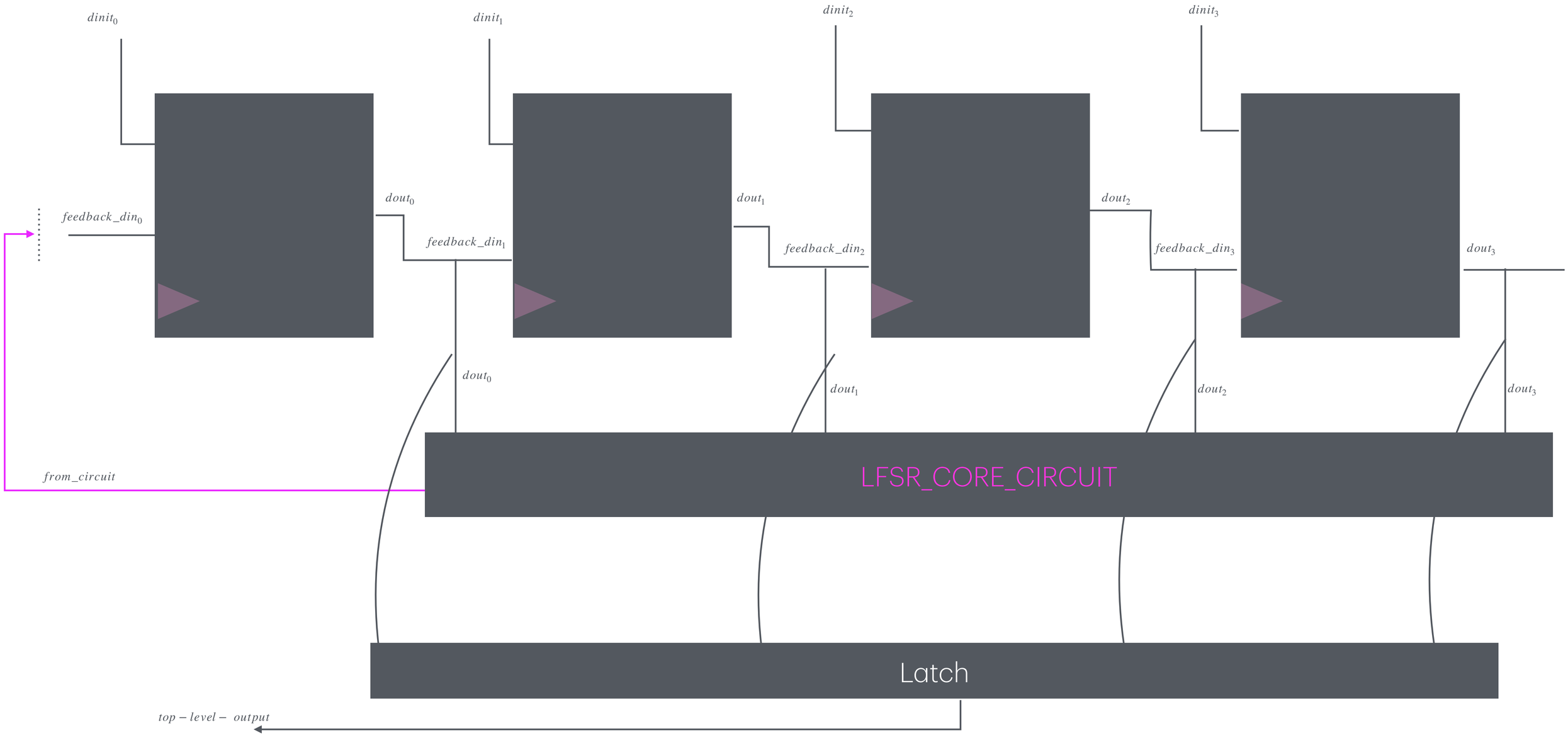
REGISTER VALUE = 2

1	0	1	0	0	0	0	0

TIME = 2

NEXT REGISTER VALUE = 5

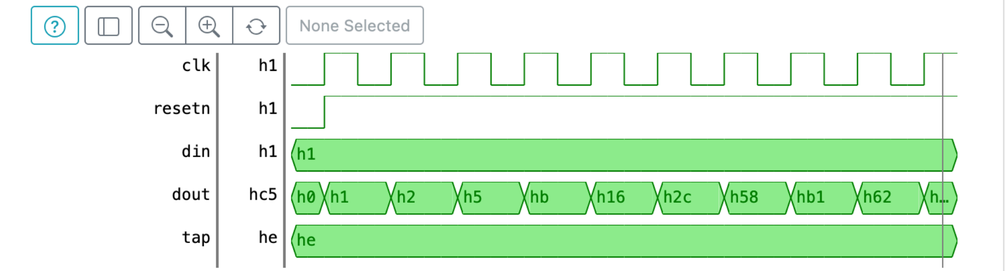
8 Bit LFSR Architecture



8 Bit LFSR Architecture

32. Configurable 8-Bit LFSR

Description | Solution

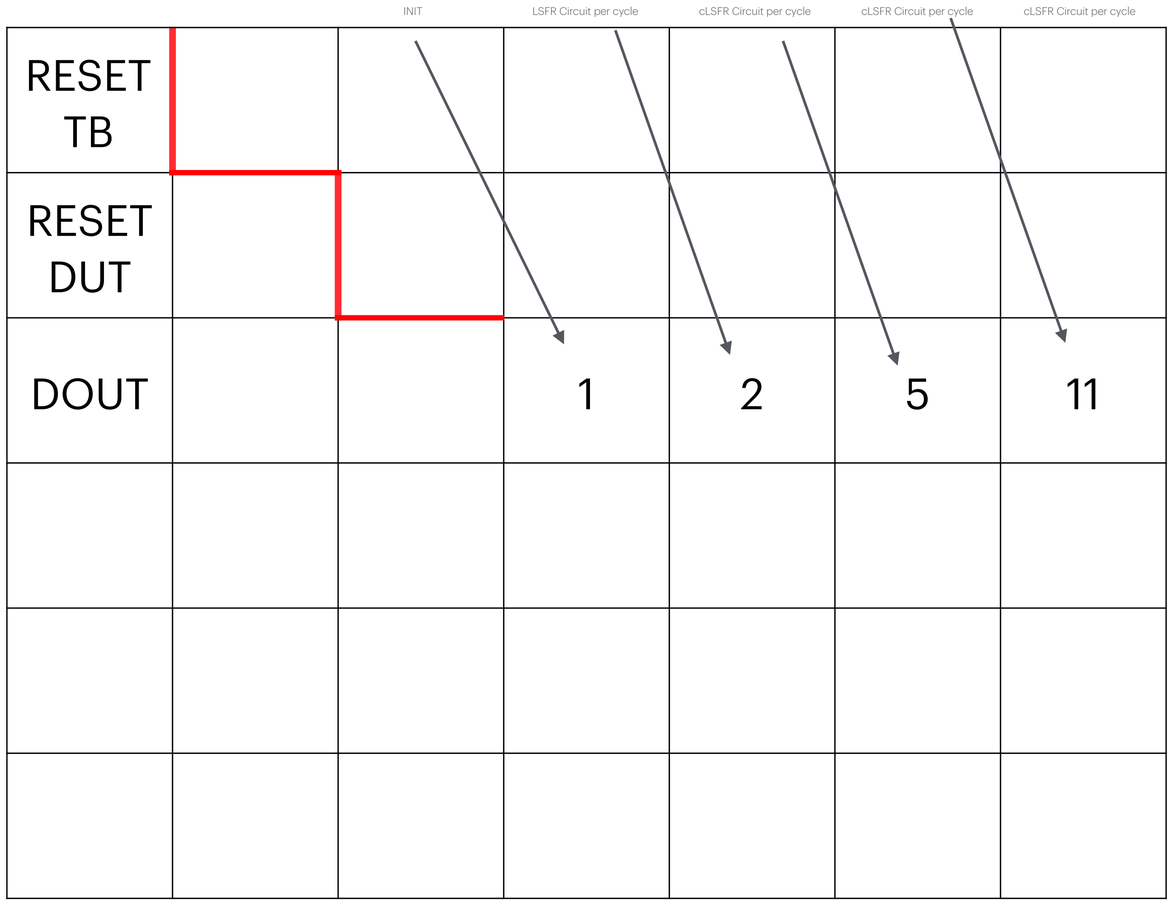


Test Model

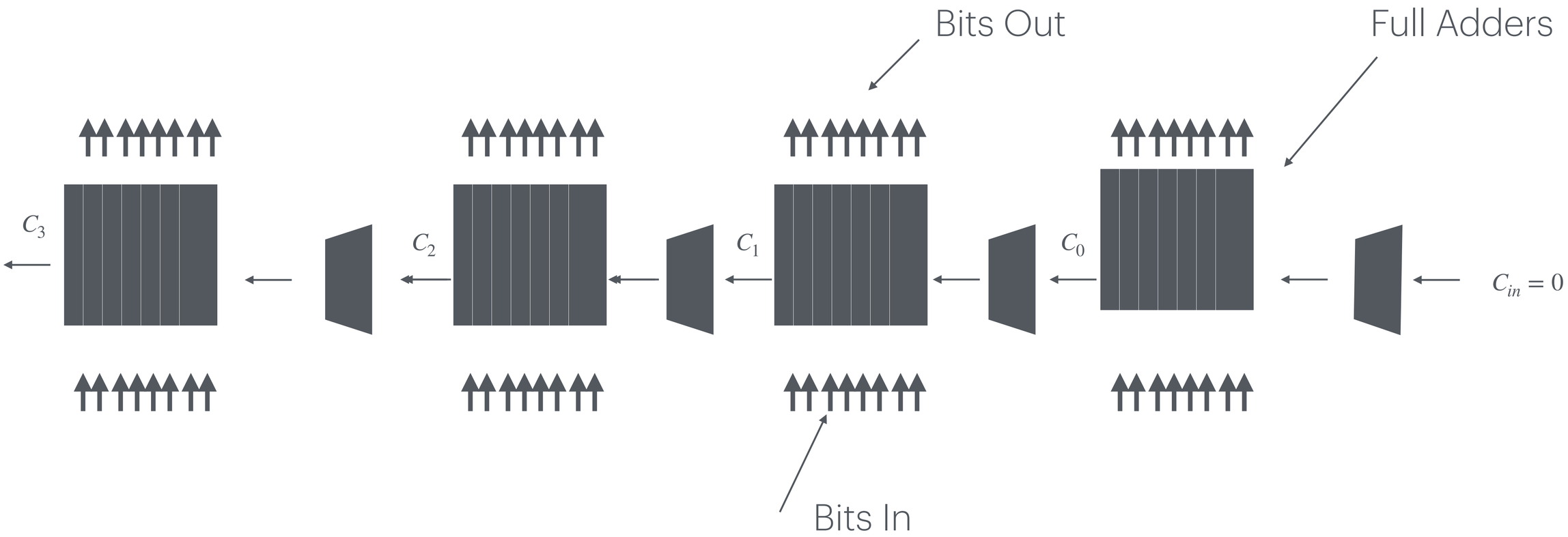
```
[2025-10-30 04:19:10 UTC] iverilog '-Wall' '-g2012' design.sv testbench.sv  && unbuffer vvp a.out
 DUT LFSR - step -  0 dout - 01
 DUT LFSR - step -  1 dout - 02
 DUT LFSR - step -  2 dout - 05
 DUT LFSR - step -  3 dout - 0b
 DUT LFSR - step -  4 dout - 16
 DUT LFSR - step -  5 dout - 2c
 DUT LFSR - step -  6 dout - 58
 DUT LFSR - step -  7 dout - b1
 DUT LFSR - step -  8 dout - 62
 DUT LFSR - step -  9 dout - c5
testbench.sv:64: $finish called at 108 (1s)
Done
```

Test Bench Logs

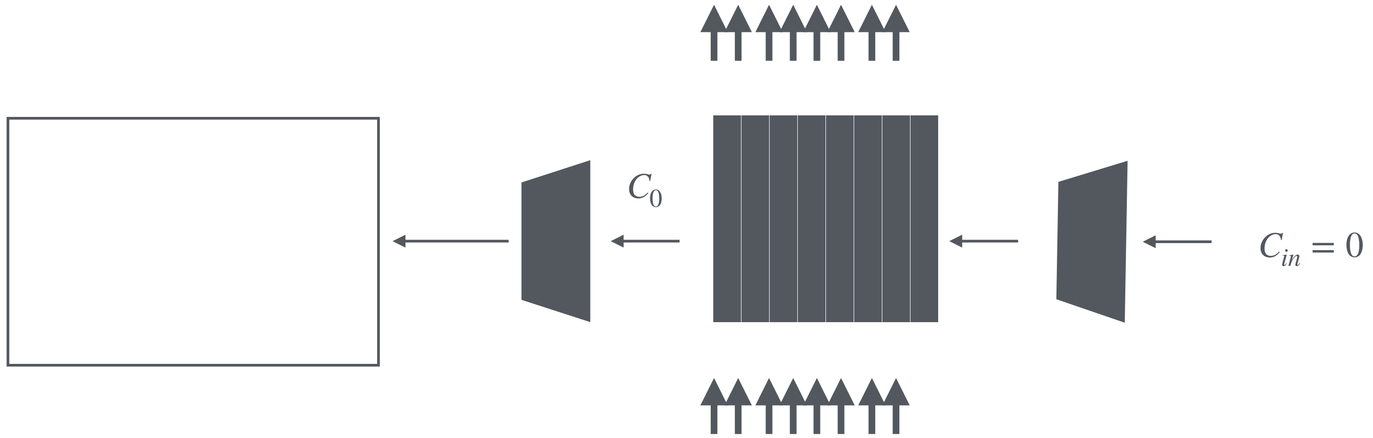
8 Bit LFSR Architecture

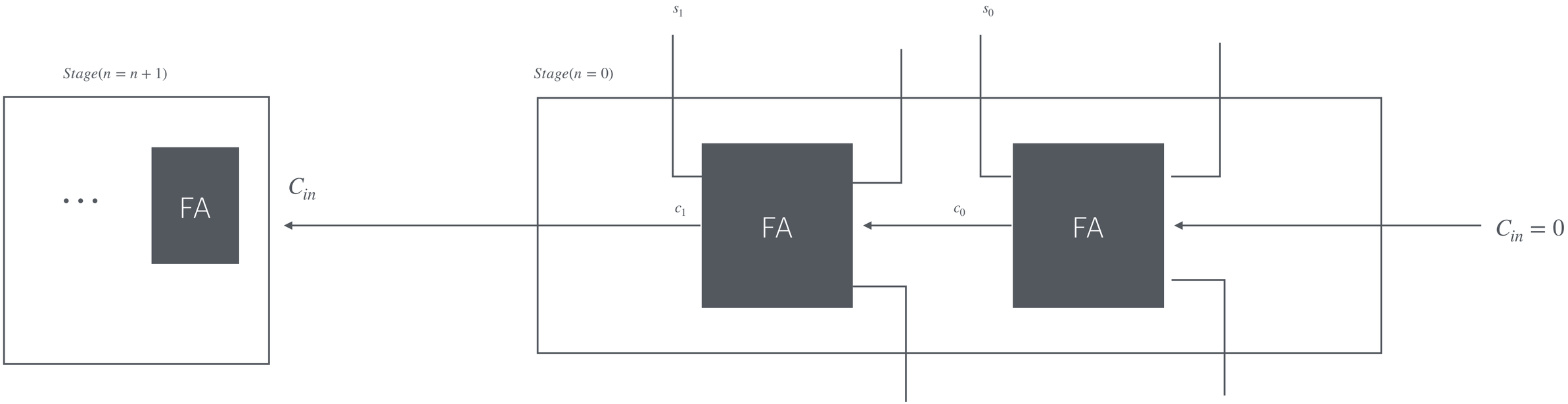


Carry Select (32 Bit)



Carry Select (Flow)





Carry Select (Logs)

```
[2025-10-30 18:35:00 UTC] iverilog '-Wall' '-g2012' design.sv testbench.sv  && unbuffer vvp a.out
MODEL 1389860 + 9002625 = 10392485      SYSTEM-ALU  1389860+ 9002625=10392485       valid=1 [10392485]  [10392485]
MODEL 8705545 + 15750755 = 7679084      SYSTEM-ALU  8705545+15750755= 7679084       valid=1 [ 7679084]  [ 7679084]
MODEL 12155661 + 14653837 = 10032282        SYSTEM-ALU 12155661+14653837=10032282       valid=1 [10032282]  [10032282]
MODEL 12747877 + 3625490 = 16373367     SYSTEM-ALU 12747877+ 3625490=16373367       valid=1 [16373367]  [16373367]
MODEL 15983361 + 14142733 = 13348878        SYSTEM-ALU 15983361+14142733=13348878       valid=1 [13348878]  [13348878]
MODEL 2355574 + 9293117 = 11648691      SYSTEM-ALU  2355574+ 9293117=11648691       valid=1 [11648691]  [11648691]
MODEL 13916141 + 3012492 = 151417       SYSTEM-ALU 13916141+ 3012492=  151417       valid=1 [  151417]  [  151417]
MODEL 16640505 + 3613894 = 3477183      SYSTEM-ALU 16640505+ 3613894= 3477183       valid=1 [ 3477183]  [ 3477183]
MODEL 16221381 + 1299114 = 743279       SYSTEM-ALU 16221381+ 1299114=  743279       valid=1 [  743279]  [  743279]
MODEL 11532261 + 13791863 = 8546908     SYSTEM-ALU 11532261+13791863= 8546908       valid=1 [ 8546908]  [ 8546908]
MODEL 3331602 + 15522703 = 2077089      SYSTEM-ALU  3331602+15522703= 2077089       valid=1 [ 2077089]  [ 2077089]
MODEL 3172850 + 7771854 = 10944704      SYSTEM-ALU  3172850+ 7771854=10944704       valid=1 [10944704]  [10944704]
MODEL 31464 + 13258437 = 13289901       SYSTEM-ALU    31464+13258437=13289901       valid=1 [13289901]  [13289901]
MODEL 5785948 + 9316541 = 15102489      SYSTEM-ALU  5785948+ 9316541=15102489       valid=1 [15102489]  [15102489]
MODEL 11229229 + 10954341 = 5406354     SYSTEM-ALU 11229229+10954341= 5406354       valid=1 [ 5406354]  [ 5406354]
MODEL 15688291 + 7571210 = 6482285      SYSTEM-ALU 15688291+ 7571210= 6482285       valid=1 [ 6482285]  [ 6482285]
MODEL 3875456 + 6562080 = 10437536      SYSTEM-ALU  3875456+ 6562080=10437536       valid=1 [10437536]  [10437536]
MODEL 7882154 + 13421725 = 4526663      SYSTEM-ALU  7882154+13421725= 4526663       valid=1 [ 4526663]  [ 4526663]
MODEL 2113174 + 8632339 = 10745513      SYSTEM-ALU  2113174+ 8632339=10745513       valid=1 [10745513]  [10745513]
MODEL 12335117 + 10999379 = 6557280     SYSTEM-ALU 12335117+10999379= 6557280       valid=1 [ 6557280]  [ 6557280]
MODEL 10476907 + 10889941 = 4589632     SYSTEM-ALU 10476907+10889941= 4589632       valid=1 [ 4589632]  [ 4589632]
MODEL 1526274 + 5652142 = 7178416       SYSTEM-ALU  1526274+ 5652142= 7178416       valid=1 [ 7178416]  [ 7178416]
MODEL 16771357 + 12939983 = 12934124        SYSTEM-ALU 16771357+12939983=12934124       valid=1 [12934124]  [12934124]
MODEL 8669475 + 615690 = 9285165        SYSTEM-ALU  8669475+  615690= 9285165       valid=1 [ 9285165]  [ 9285165]
MODEL 7539402 + 3230780 = 10770182      SYSTEM-ALU  7539402+ 3230780=10770182       valid=1 [10770182]  [10770182]
MODEL 6864370 + 3039626 = 9903996       SYSTEM-ALU  6864370+ 3039626= 9903996       valid=1 [ 9903996]  [ 9903996]
MODEL 12890945 + 4928728 = 1042457      SYSTEM-ALU 12890945+ 4928728= 1042457       valid=1 [ 1042457]  [ 1042457]
MODEL 2159480 + 9048713 = 11208193      SYSTEM-ALU  2159480+ 9048713=11208193       valid=1 [11208193]  [11208193]
MODEL 12914155 + 157110 = 13071265      SYSTEM-ALU 12914155+  157110=13071265       valid=1 [13071265]  [13071265]
MODEL 4979142 + 1381294 = 6360436       SYSTEM-ALU  4979142+ 1381294= 6360436       valid=1 [ 6360436]  [ 6360436]
MODEL 7668412 + 1039658 = 8708070       SYSTEM-ALU  7668412+ 1039658= 8708070       valid=1 [ 8708070]  [ 8708070]
MODEL 14129675 + 9944689 = 7297148      SYSTEM-ALU 14129675+ 9944689= 7297148       valid=1 [ 7297148]  [ 7297148]
Done
```