2-1 Mux

Design.v | Untitled 1

D:/Vivado/Multiplexer 2 to 1/Multiplexer 2 to 1.srcs/sources_1/new/Design.v

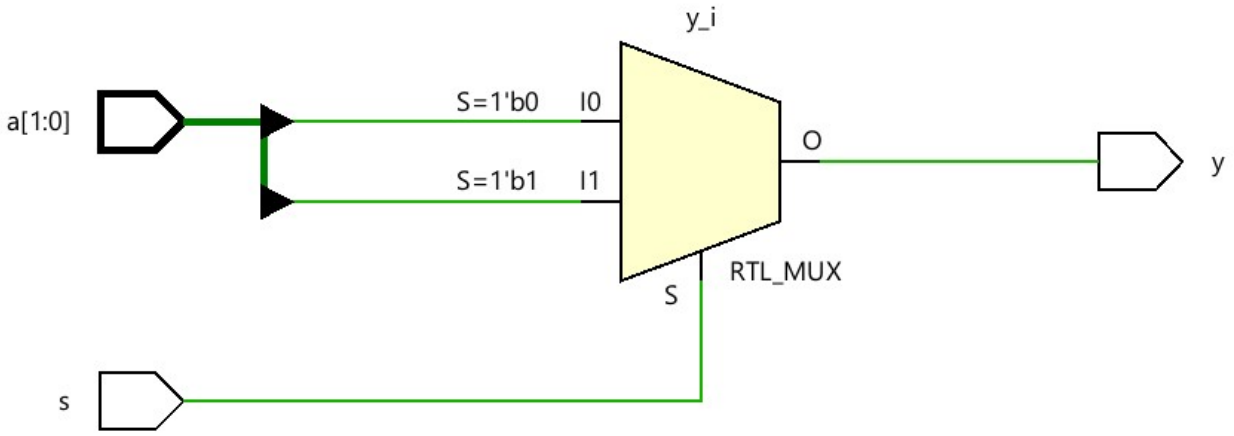
```
1  //Design code
2  module mux(input [1:0]a,input s,output reg y);
3    always@(s or a) begin
4      case(s)
5        1'b0: y=a[0];
6        1'b1: y=a[1];
7        default: y=1'bx;
8      endcase
9    end
10 endmodule
11
12
```

Testbench.v *

D:/Vivado/Multiplexer 2 to 1/Multiplexer 2 to 1.srcs/sim_1/new/Testbench.v

```
1  //test bench
2  module tb_mux;
3    reg [1:0]a;
4    reg s;
5    wire y;
6    mux u1(.y(y),.s(s),.a(a));
7    initial begin
8      $monitor("s=%0b,y=%0b",s,y);
9      a=2'b10;
10     s=0;
11     #10;
12     s=1;
13   end
14 endmodule
```

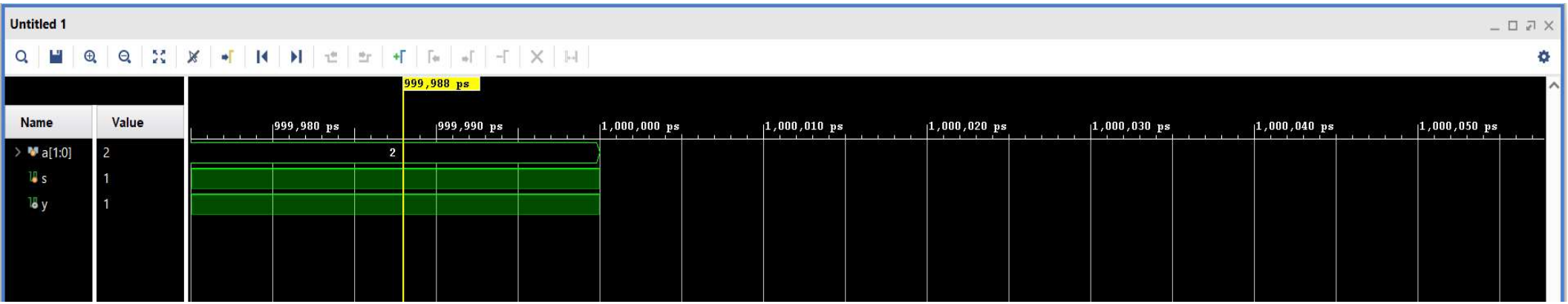
Digram



OUTPUT

```
# KERNEL: s=0,y=0
# KERNEL: s=1,y=1
```

Timing Digram



A **2-to-1 multiplexer (MUX)** is a combinational circuit that selects one of two input signals based on a single select line and forwards it to the output. It is one of the simplest types of multiplexers and is widely used in digital circuits for signal routing and selection.

Functionality

- **Inputs:** Two data inputs (I0/0 and I1/1) and one select line (S*S*).
- **Output:** A single output (Y*Y*) that corresponds to the selected input.
- **Operation:**
  - When S=0*S*=0, Y=I0*Y*=*I*0.
  - When S=1*S*=1, Y=I1*Y*=*I*1.

Truth Table

Select Line (S*S*)	Output (Y*Y*)
0	I0/0
1	I1/1

Boolean Expression

The output of the 2-to-1 MUX can be expressed as:

Y=S¯I0+SI1*Y*=*SI*0+*S*I1

Implementation

The circuit for a 2-to-1 MUX can be implemented using:

- **Logic Gates:** Two AND gates, one NOT gate, and one OR gate.
  - The NOT gate inverts the select line ($S^{-}S$).
  - Each AND gate combines one input with either S*S* or $S^{-}S$.
  - The OR gate combines the outputs of the two AND gates to produce the final output.

Applications

1. **Signal Routing:** Selects between two signals in communication systems.
2. **Control Systems:** Used in microcontrollers to choose between different data sources or instructions.
3. **Arithmetic Circuits:** Helps in implementing logic gates like AND, OR, etc., using multiplexers.
4. **Data Selection:** Routes data from multiple sources to a single destination.

Advantages

- Simple design and implementation.
- Efficient signal selection for small-scale systems.

In summary, a 2-to-1 MUX is a foundational building block in digital electronics that enables efficient signal selection and routing with minimal hardware. It is frequently used in FPGA designs, microprocessors, and control systems.