

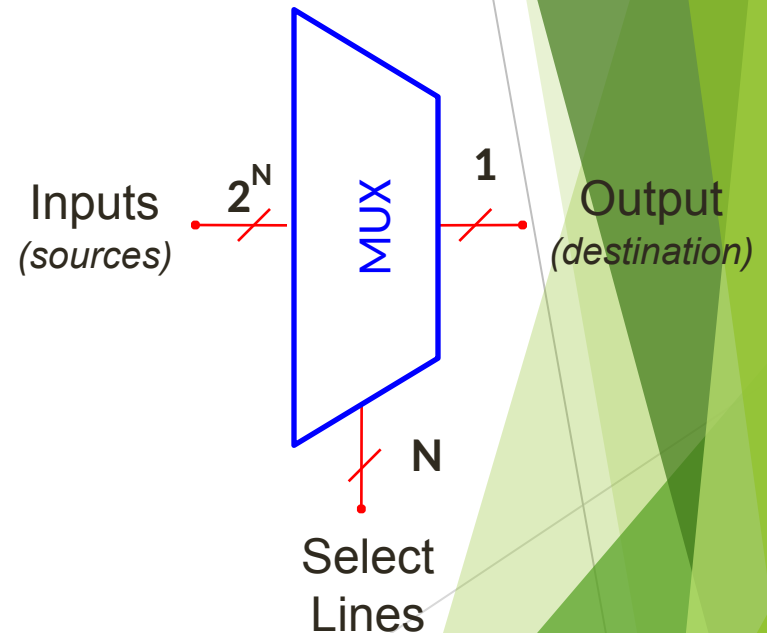
Shifter Design

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What is a Multiplexer (MUX)?

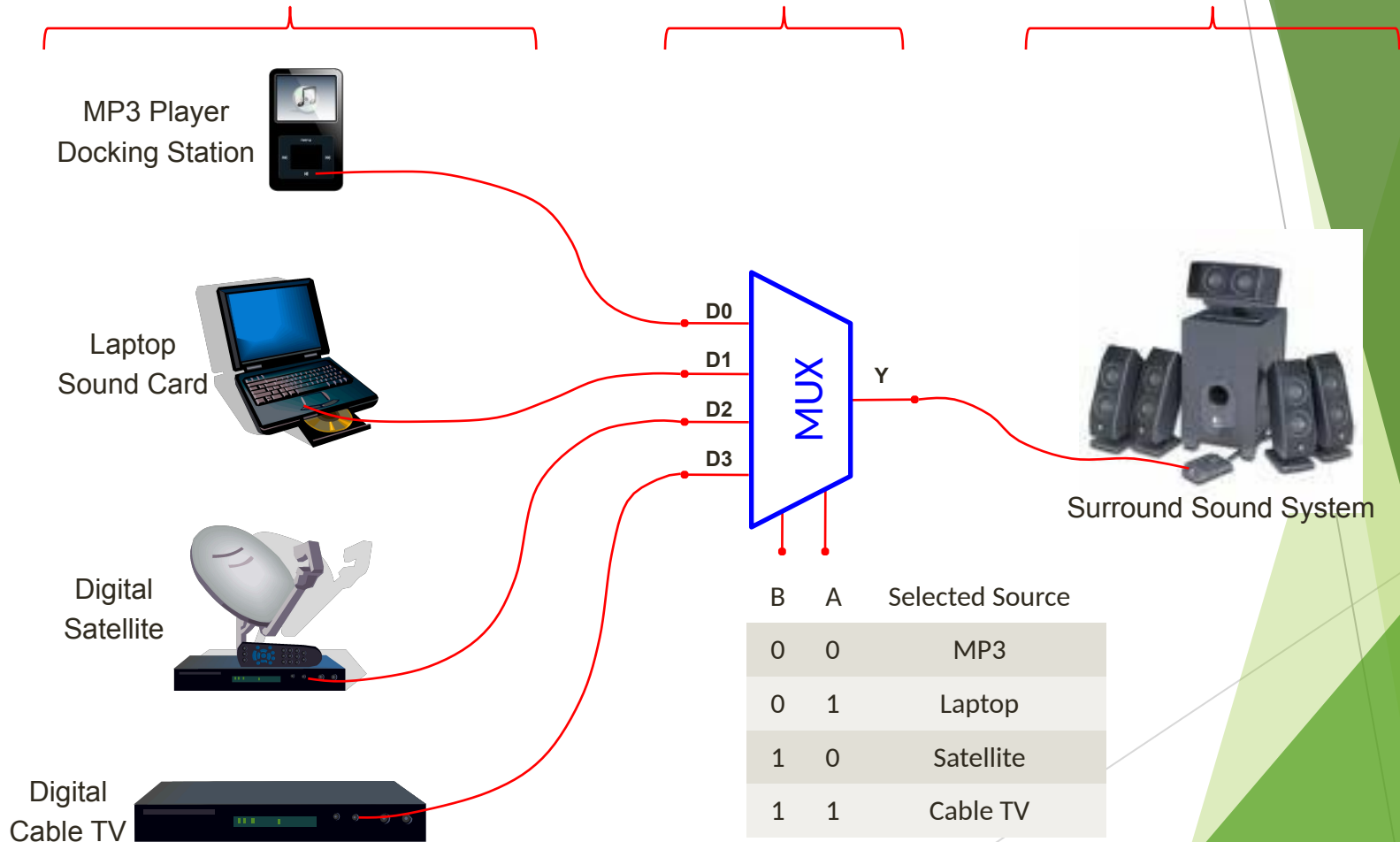
- A MUX is a digital switch that has multiple inputs (sources) and a single output (destination).
- The select lines determine which input is connected to the output.
- MUX Types
 - ? 2-to-1 (1 select line)
 - ? 4-to-1 (2 select lines)
 - ? 8-to-1 (3 select lines)
 - ? 16-to-1 (4 select lines)

Multiplexer Block Diagram

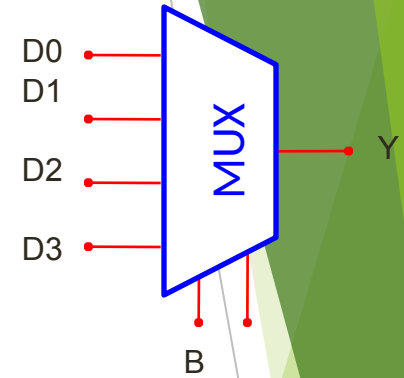
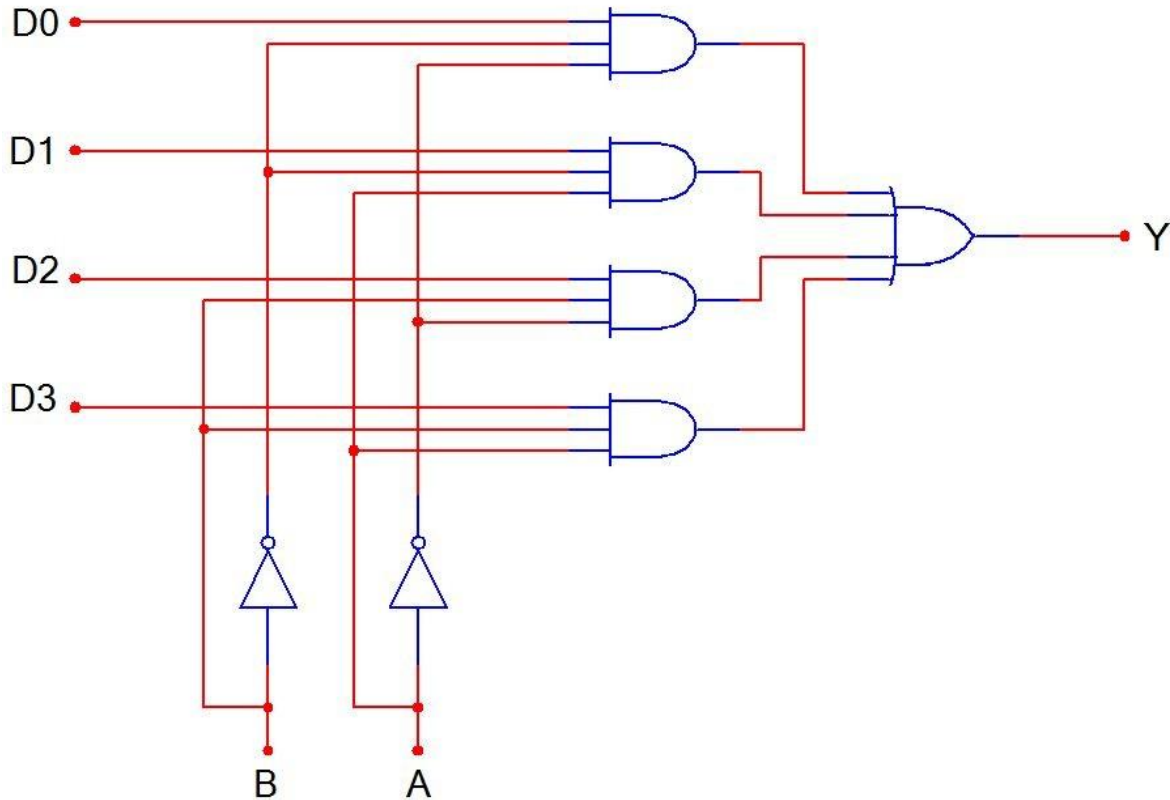


Typical Application of a MUX

Multiple Sources Selector Single Destination



4-to-1 Multiplexer (MUX)



| B | A | Y |
|---|---|----|
| 0 | 0 | D0 |
| 0 | 1 | D1 |
| 1 | 0 | D2 |
| 1 | 1 | D3 |

4-to-1 Multiplexer (MUX)

Now let's try it on Proteus.

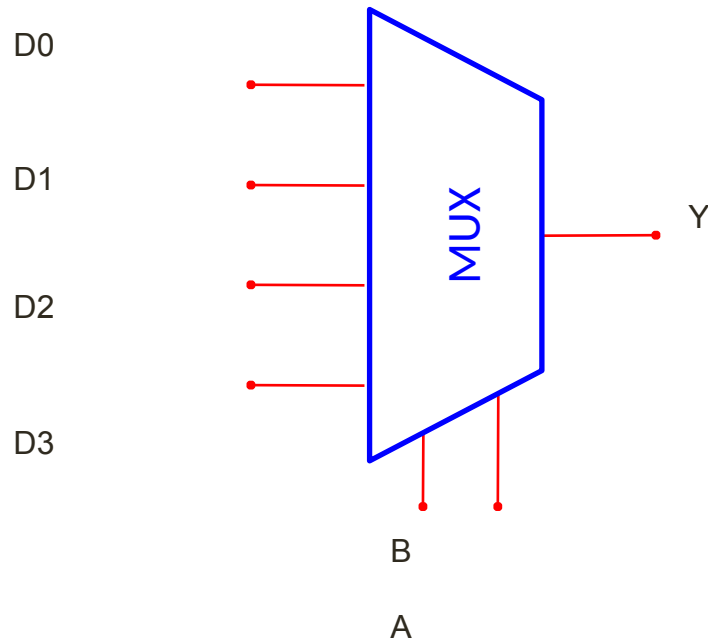
Designing a 4 bit shifter

Table 9-7 Function table for shifter

| H_1 | H_0 | Operation | Function |
|-------|-------|------------------------------|--------------------------------|
| 0 | 0 | $S \leftarrow F$ | Transfer F to S (no shift) |
| 0 | 1 | $S \leftarrow \text{shr } F$ | Shift-right F into S |
| 1 | 0 | $S \leftarrow \text{shl } F$ | Shift-left F into S |
| 1 | 1 | $S \leftarrow 0$ | Transfer 0's into S |

Designing a 4 bit shifter

- We need 4:1 MUX



Question is: How many MUX??

Designing a 4 bit shifter

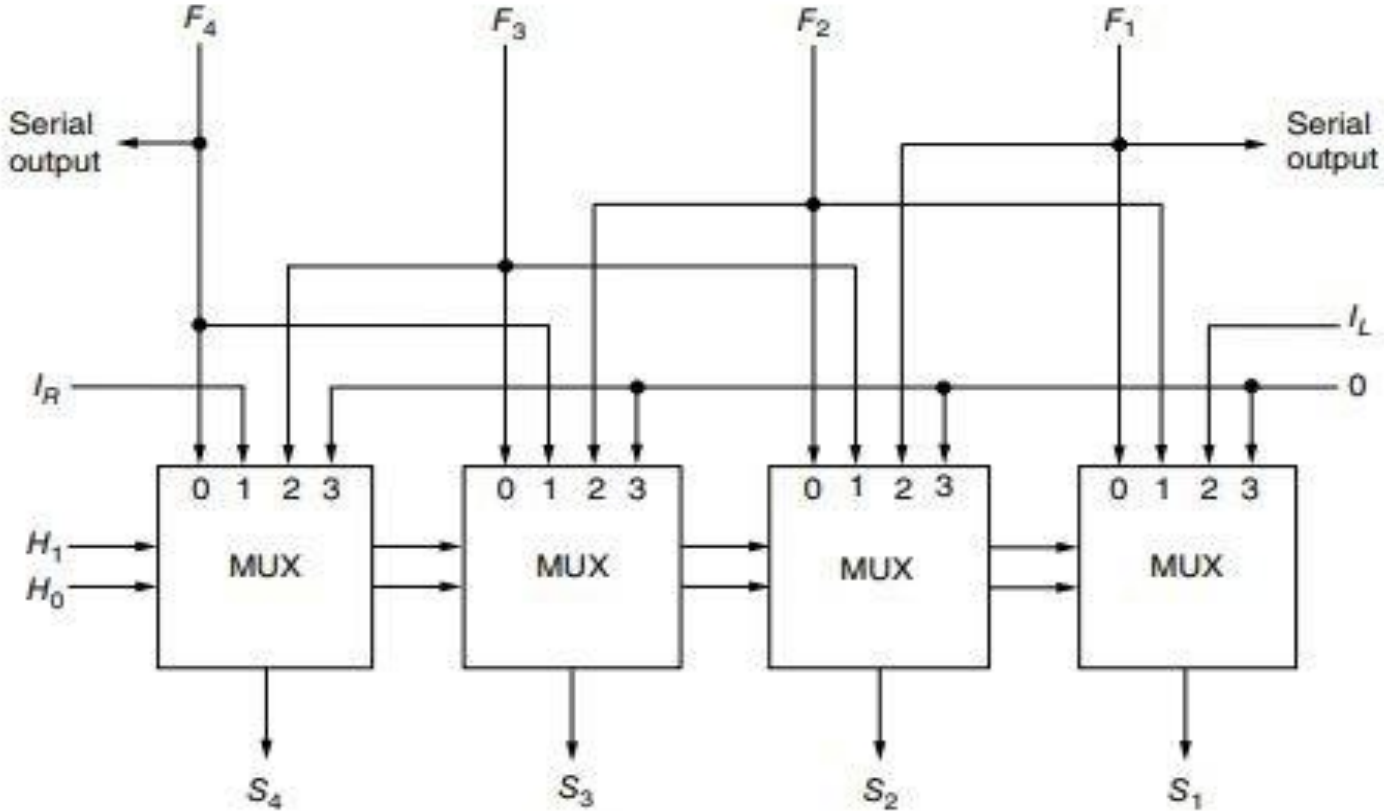


Figure 9-15 4-bit combinational-logic shifter

DesigningShifter

- So while designing a shifter we need to decide:
 - How many MUX?
 - Depends on the bits of the shifter
 - Size of the MUX?
 - Depends on the number of the operation

Designing shifter

Design a 4-bit combinational logic shifter having following operations. Consider S as output, F as input and H as selection variable [Only use basic gates for design].

| H ₂ | H ₁ | H ₀ | Operation | Function |
|----------------|----------------|----------------|-------------------------------|----------------------|
| 0 | 0 | 0 | $S \leftarrow F$ | Transfer |
| 0 | 0 | 1 | $S \leftarrow F'$ | Complement transfer |
| 0 | 1 | 0 | $S \leftarrow \text{shr } F$ | Logical shift right |
| 0 | 1 | 1 | $S \leftarrow \text{shl } F$ | Logical shift left |
| 1 | 0 | 0 | $S \leftarrow \text{cshr } F$ | Circular shift right |
| 1 | 1 | 1 | $S \leftarrow \text{all 1's}$ | Transfer 1's |

So,

1. We need 4 MUXs as it is a 4-bit shifter.
2. We need 8:1 MUX as there are 6 operations in total.

DesigningShifter

Now let's try it on Proteus.