Multiplexer and Demultiplexer

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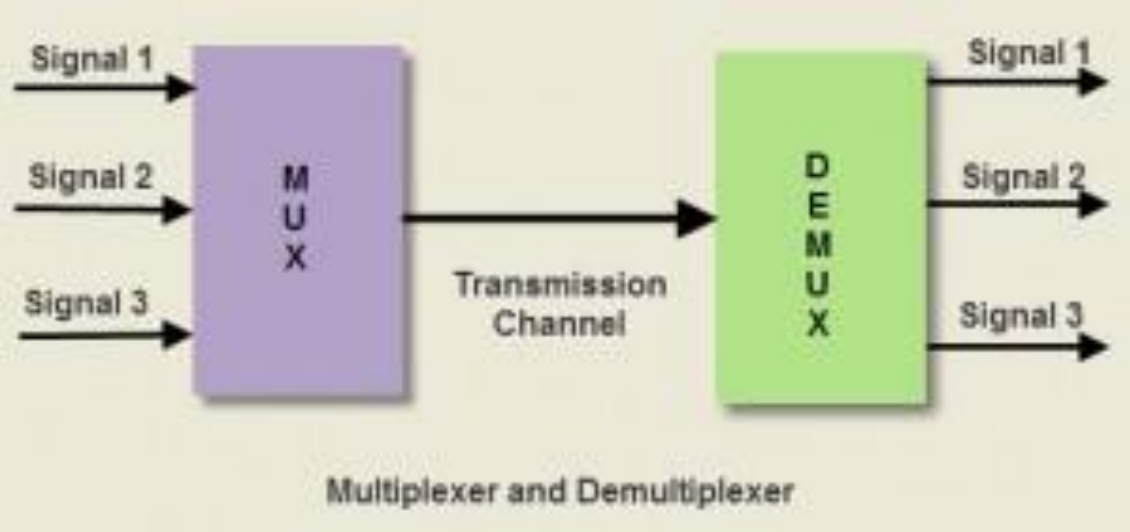
Multiplexer and Demultiplexer

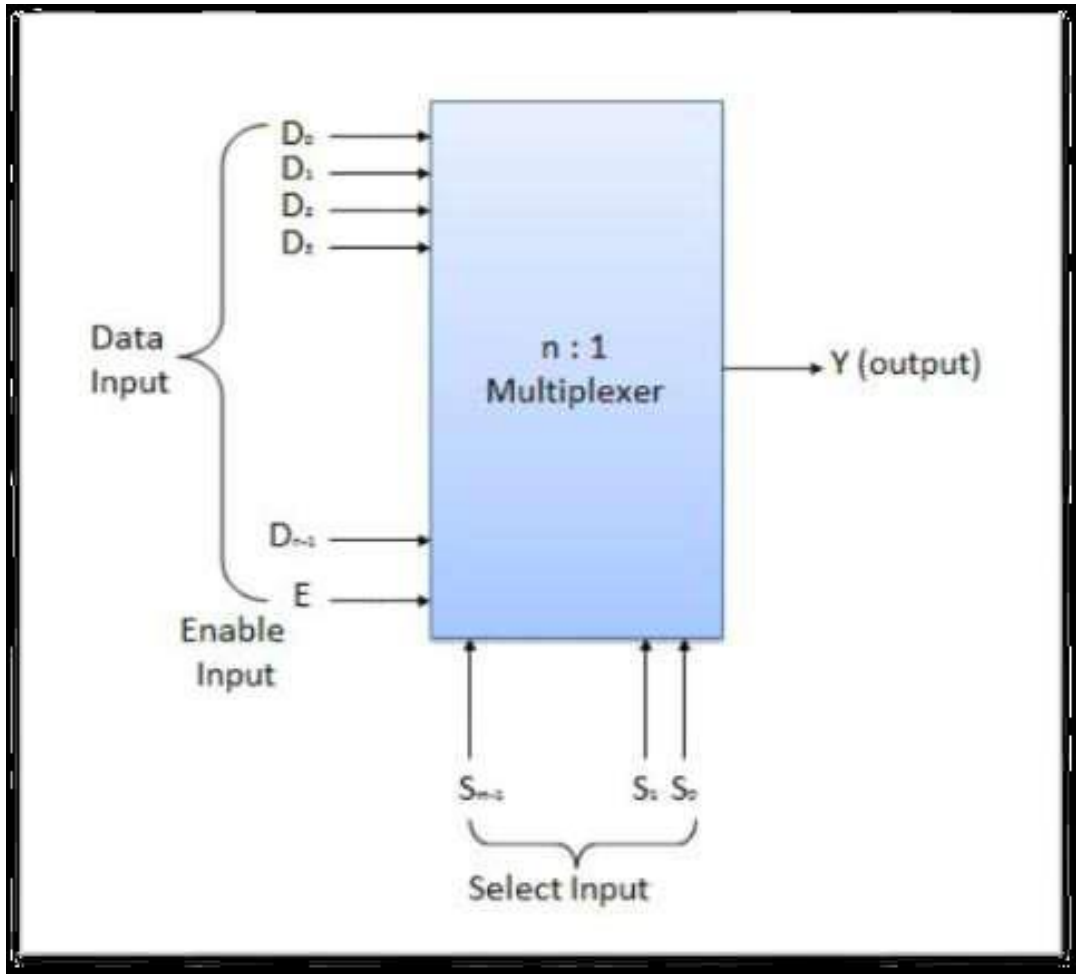
- In-network transmission, both the multiplexer and demultiplexer are combinational circuits.
- A multiplexer selects an input from several inputs then it is transmitted in the form of a single line.
- An alternative name of the multiplexer is MUX or data selector.
- A demultiplexer uses one input signal and generates many.
- It is known as Demux or data distributor.

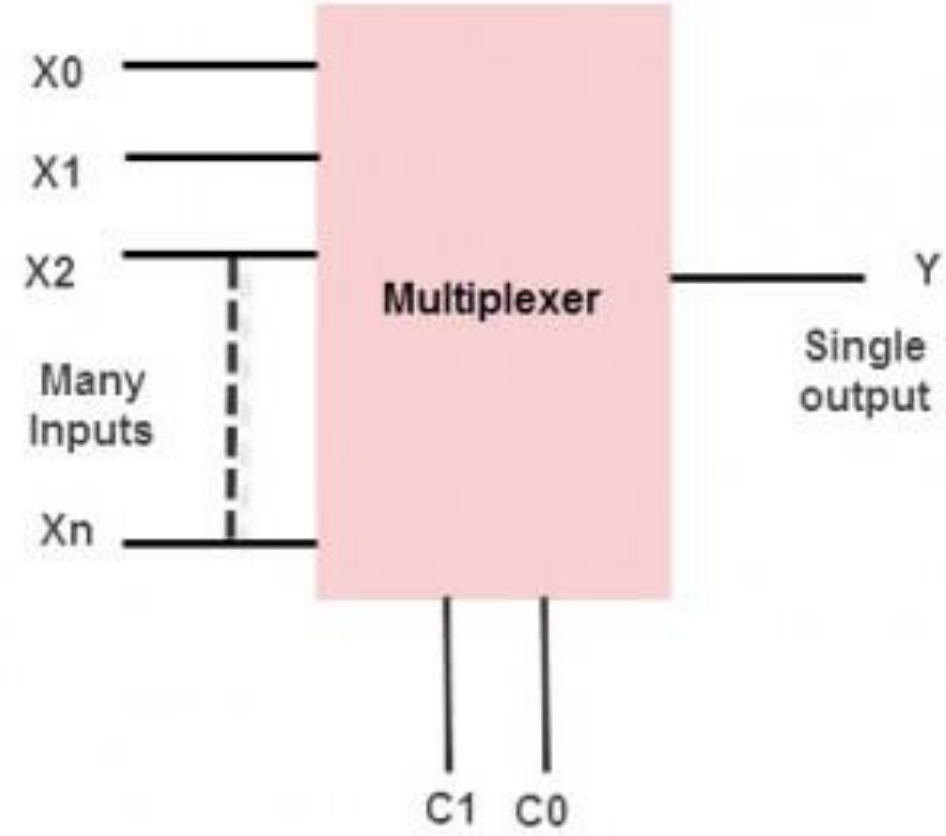


Multiplexer

- A MULTIPLEXER is a **digital circuit that has multiple inputs and a single output**.
- The selection of one of the n inputs is done by the select inputs
- It has one output selected at a time.
- It is also known as **DATA SELECTOR**.
- A multiplexer has
  - N data inputs(multiple)
  - 1 output (single)
  - M select inputs, with 2^M = N

Multiplexer



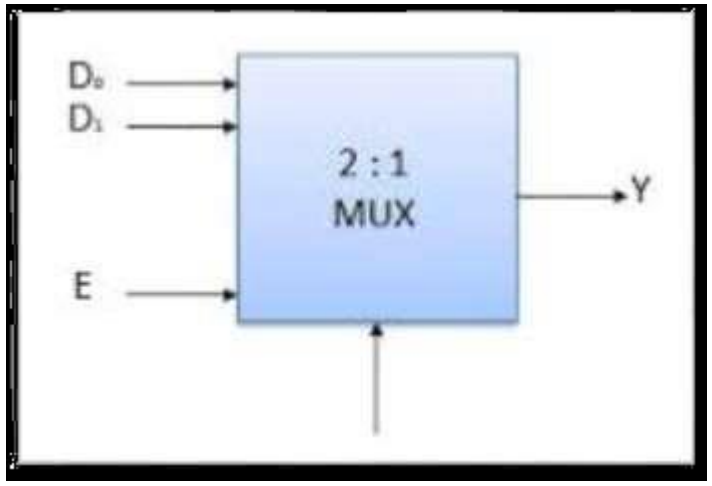


Block Diagram of Multiplexer

Multiplexer

2 to 1 line multiplexer:

Block Diagram



Truth Table

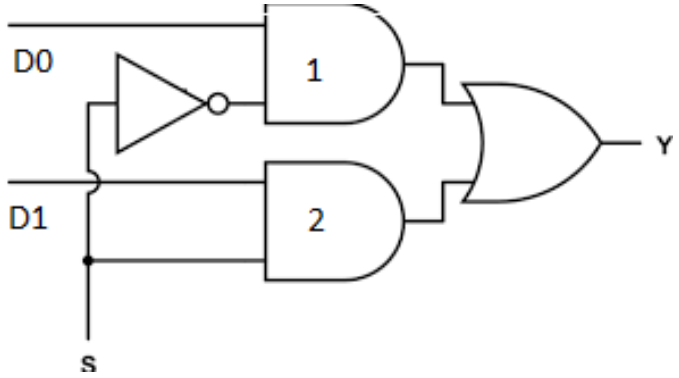
S	OUTPUT Y
0	D0
1	D1

Multiplexer

- The logical level applied to the S input determines which AND gate is enabled, so that its data input passes through the OR gate to the output.

- The output, Y=D0S'+D1S

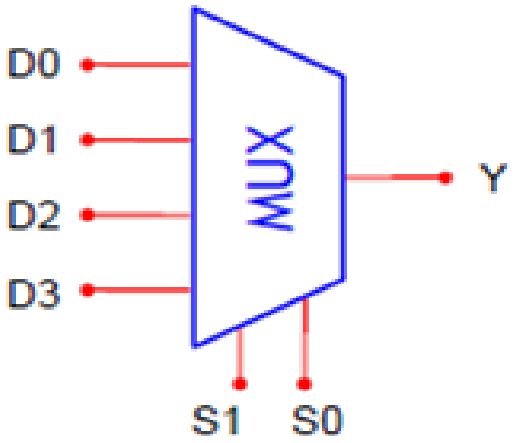
- When
  - S=0,AND gate 1 is enabled and AND gate 2 is disabled. So, Y=D0
  - S=1,AND gate 1 is disabled and AND gate 2 is enabled . So, Y=D1



Multiplexer

4 to 1 line multiplexer:

Block Diagram

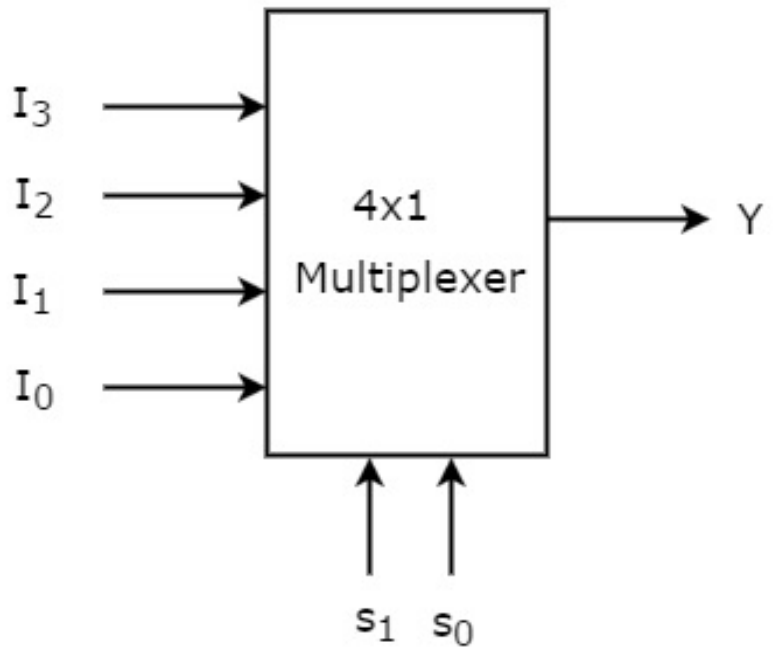


Truth Table

S1	S0	Y
0	0	D0
0	1	D1
1	0	D2
1	1	D3

Multiplexer

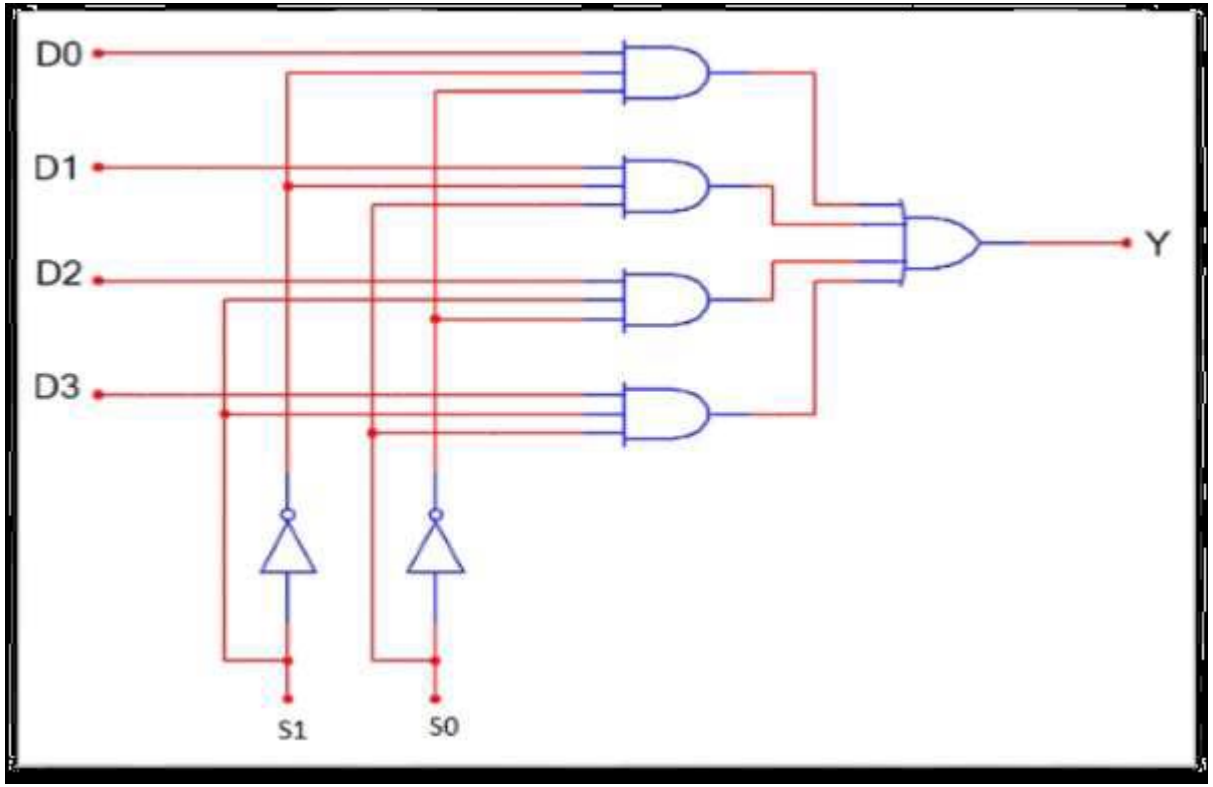
Selection Lines		Output
S_1	S_0	Y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3



$$Y = S_1'S_0'I_0 + S_1'S_0I_1 + S_1S_0'I_2 + S_1S_0I_3$$

Multiplexer

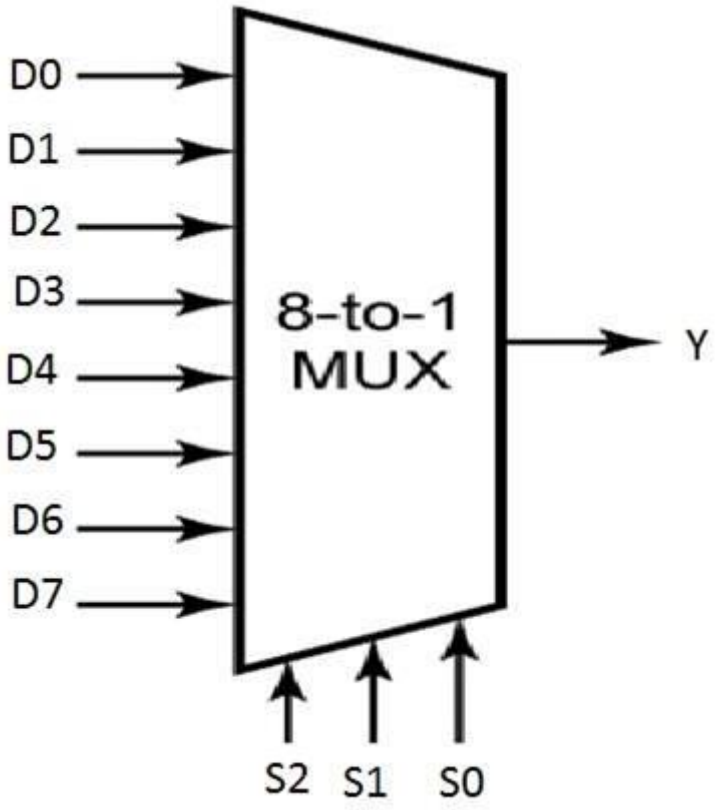
- The logical level applied to the S input determines which AND gate is enabled, so that its data input passes through the OR gate to the output.
- The output, Y=S1’S0’D0+S1’S0D1+S1SO’D2+S1S0D3



Multiplexer

8 to 1 line multiplexer:

Block Diagram

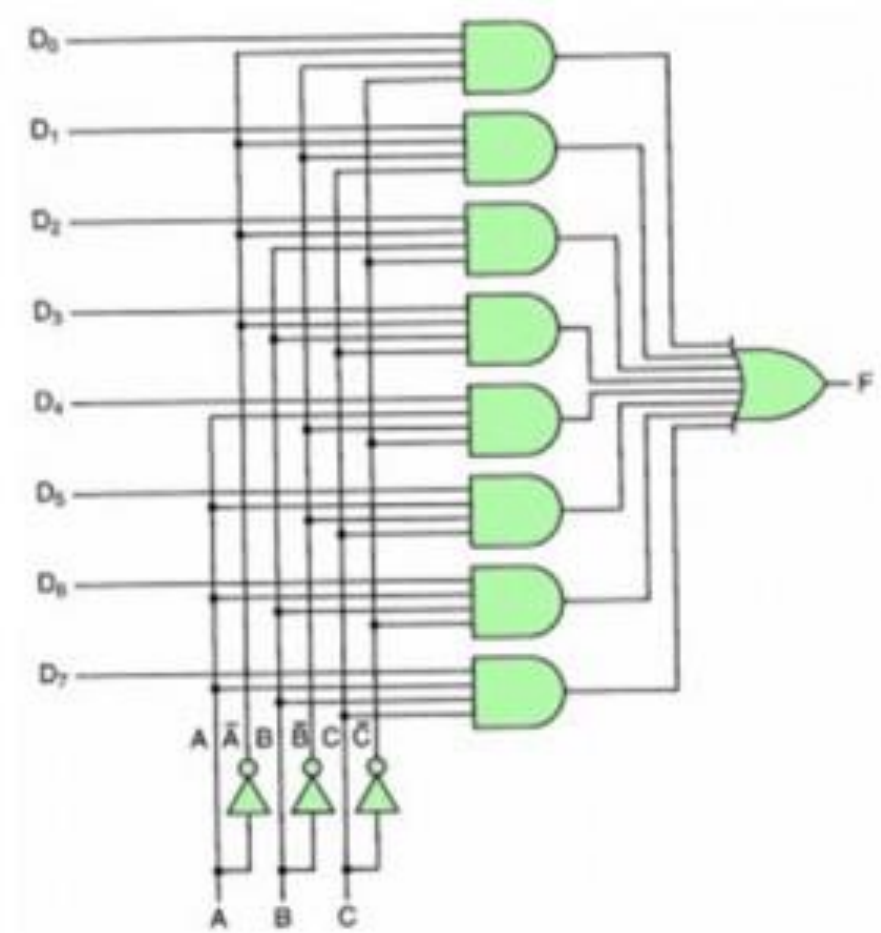


Truth Table

S2	S1	S0	Y
0	0	0	D0
0	0	1	D1
0	1	0	D2
0	1	1	D3
1	0	0	D4
1	0	1	D5
1	1	0	D6
1	1	1	D7

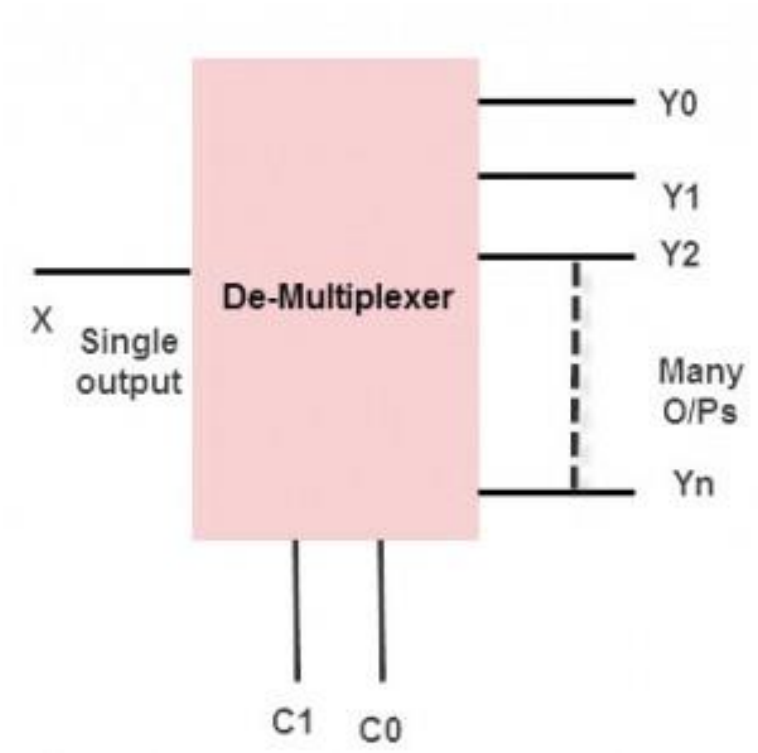
Multiplexer

- In this 8*1 multiplexer, for any selection line input, one AND gate gives a value of 1 and the remaining all AND gates give 0. And, finally, by using OR gates, all the AND gates are added; and, this will be equal to the selected value.



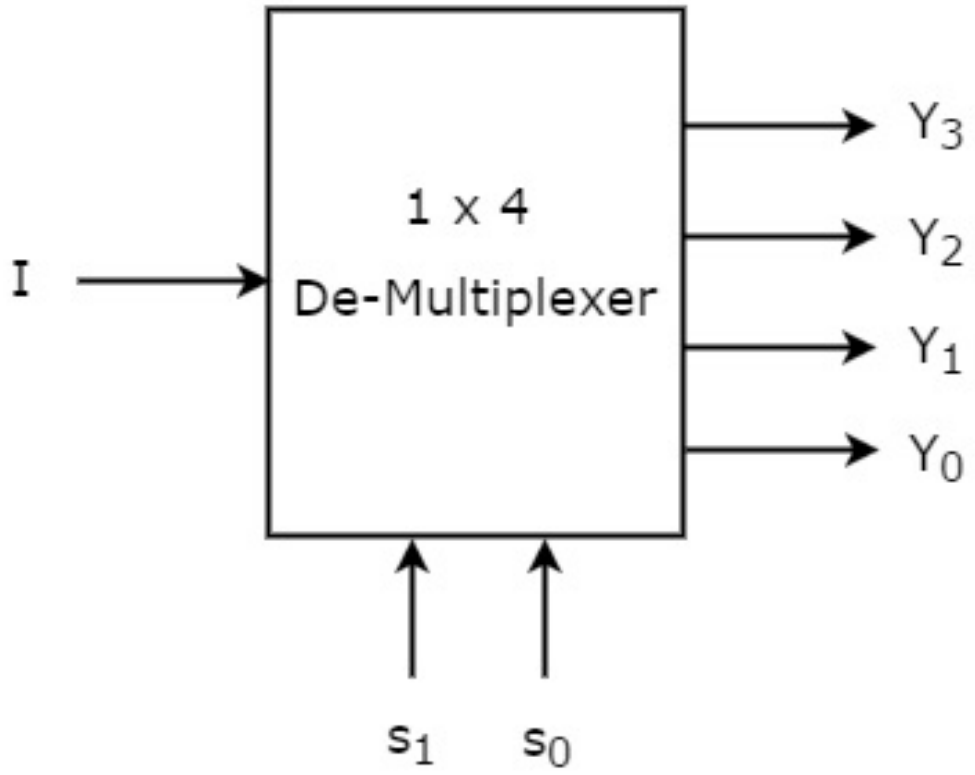
Demultiplexer

- De-multiplexer is also a device with one input and multiple output lines. It is used to send a signal to one of the many devices.



Demultiplexer

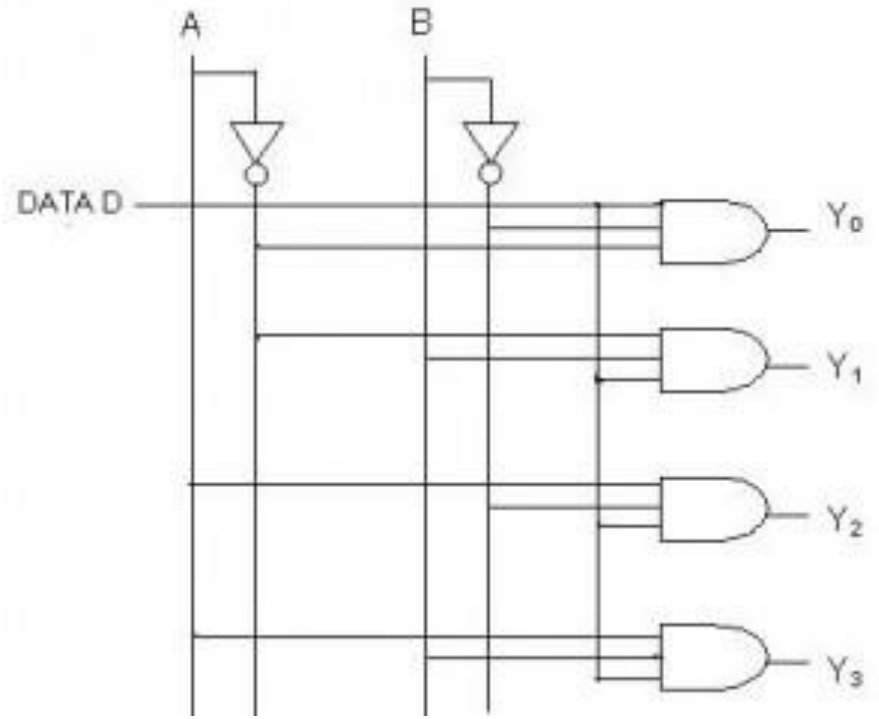
1-4 Demultiplexer : The 1-to-4 demultiplexer comprises 1- input bit, 4-output bits, and control bits. The 1x4 demultiplexer circuit diagram is shown below.



Selection Inputs		Outputs			
S_1	S_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	**I**
0	1	0	0	**I**	0
1	0	0	**I**	0	0
1	1	**I**	0	0	0

Demultiplexer

1-4 Demultiplexer : The 1-to-4 demultiplexer comprises 1- input bit, 4-output bits, and control bits. The 1x4 demultiplexer circuit diagram is shown below.



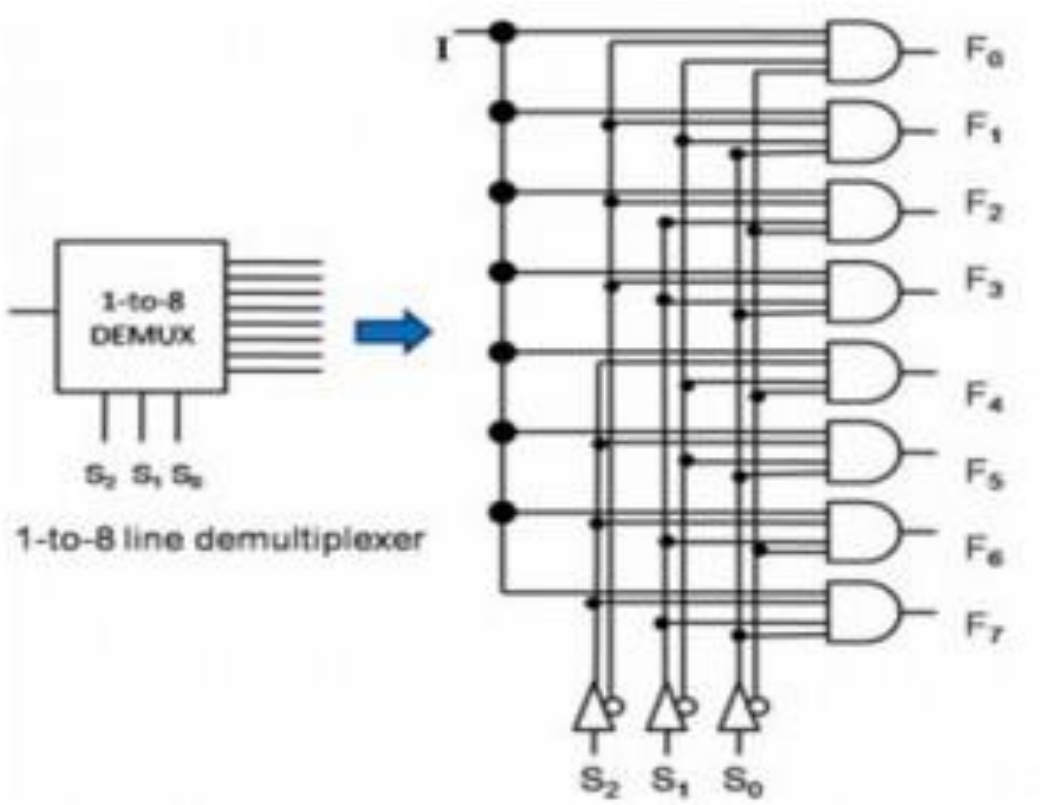
1X4 Demux

When the control i/p AB = 01, the upper second AND gate is permitted while the remaining AND gates are restricted. Thus, only data bit D is transmitted to the output, and Y1 = Data.

Demultiplexer

1-8 Demultiplexer: The demultiplexer is also called a data distributor as it requires one input, 3 selected lines, and 8 outputs.

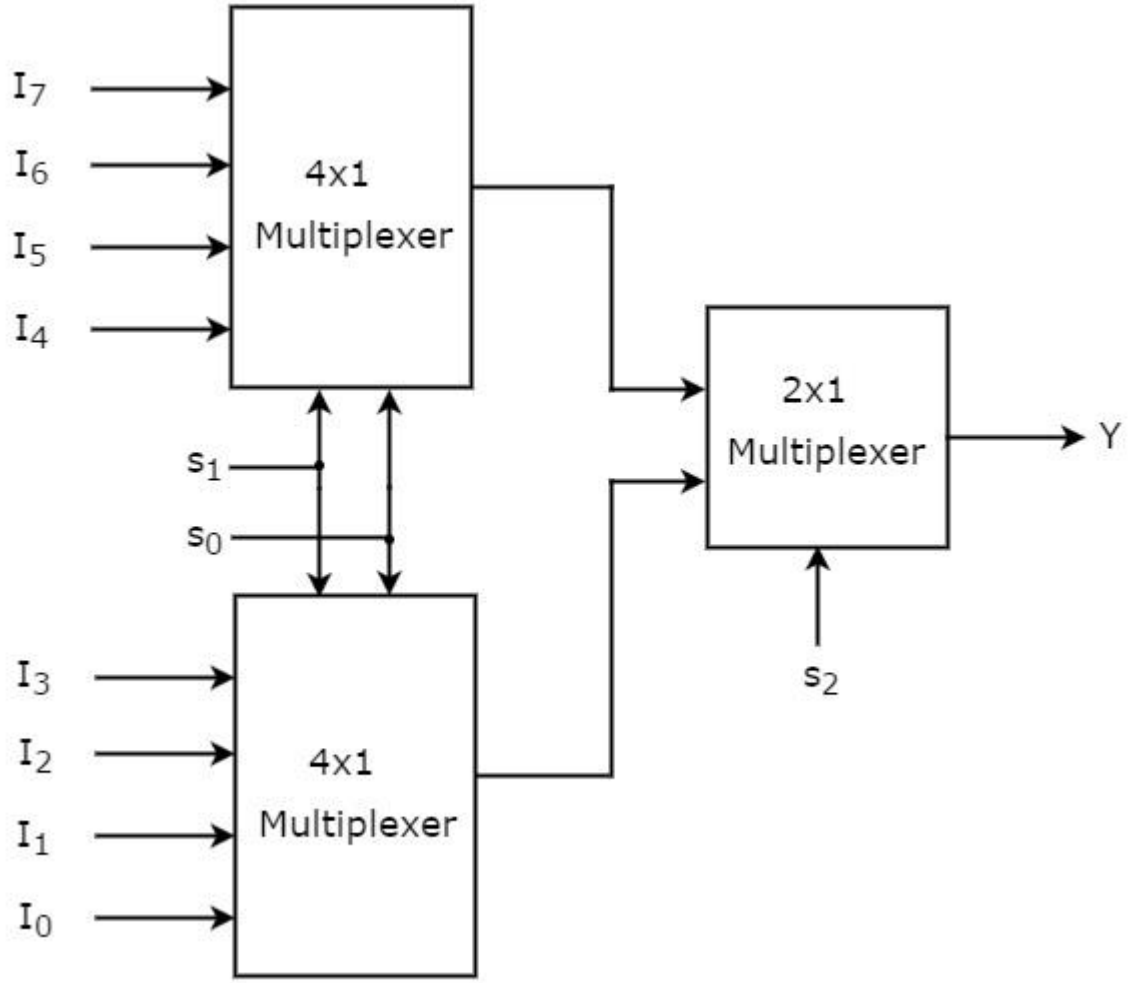
1X8 Demux



The input bit is considered as data D and it is transmitted to the output lines. This depends on the control input value of the AB. When AB = 01, the upper second gate F1 is enabled, while the remaining AND gates are disabled, and the data bit is transmitted to the output giving F1= data. If D is low, the F1 is low, and if D is high, the F1 is high. So the value of the F1 depends on the value of D, and the remaining outputs are in the low state

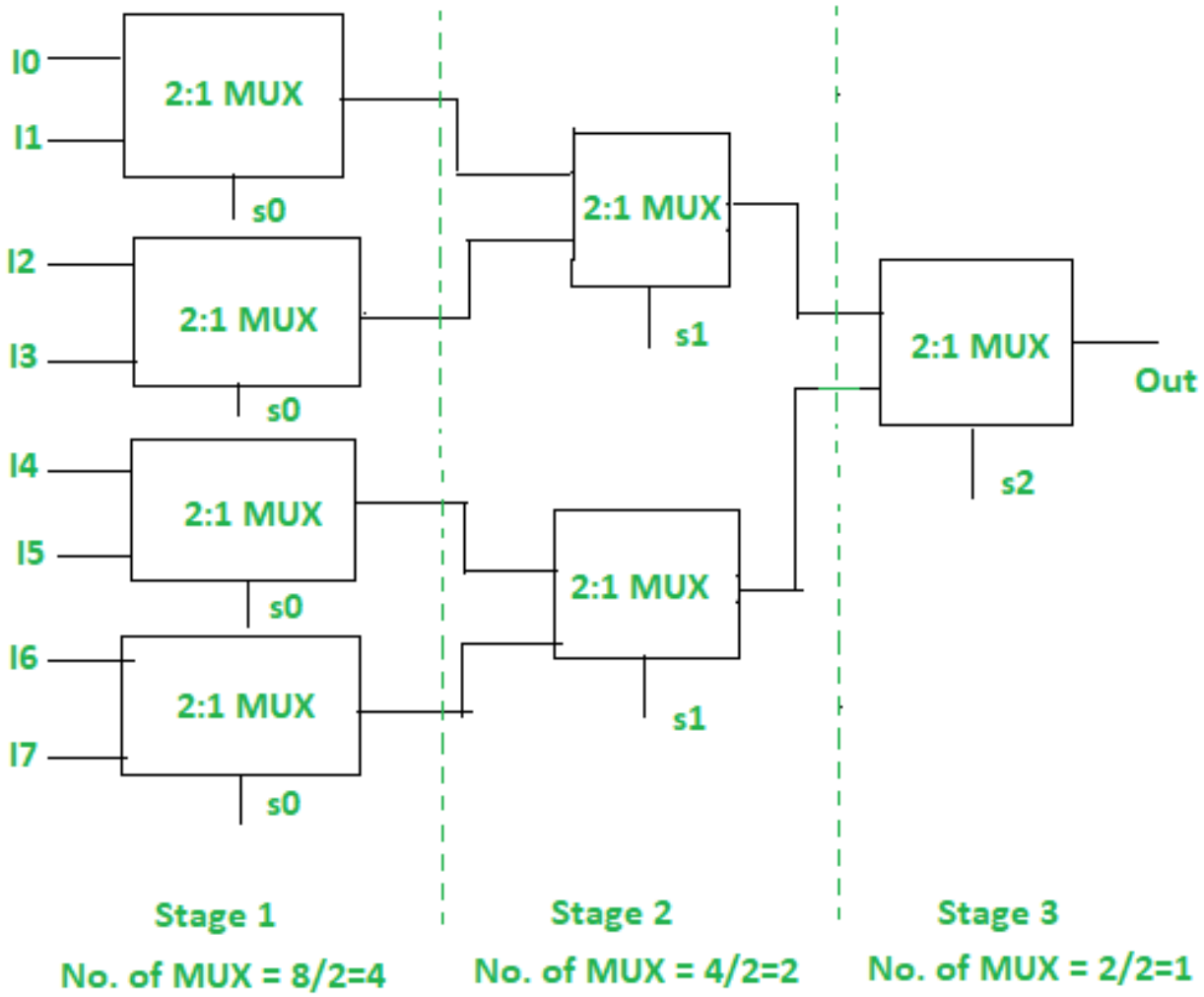
8 x 1 Mux using lower order Multiplexers

Implement 8x1 Multiplexer using 4x1 Multiplexers and 2x1 Multiplexer.



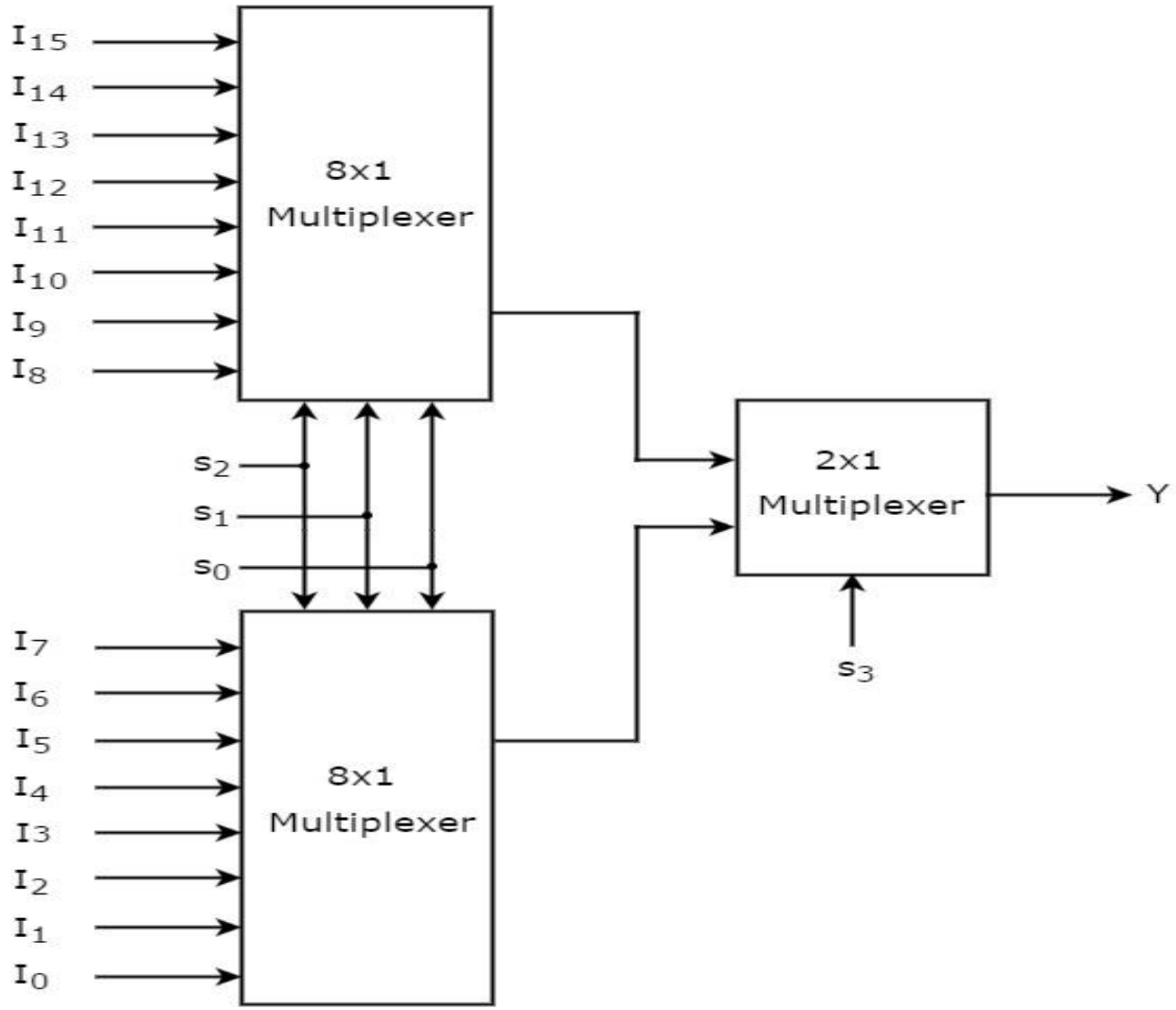
8 x 1 Mux using 2 x 1 Mux

Implement 8x1 Multiplexer using 2x1 Multiplexer.



16 x 1 Mux

16x1 Multiplexer



Selection Inputs				Output
S_3	**S_2**	**S_1**	**S_0**	**Y**
0	0	0	0	I_0
0	0	0	1	I_1
0	0	1	0	I_2
0	0	1	1	I_3
0	1	0	0	I_4
0	1	0	1	I_5
0	1	1	0	I_6
0	1	1	1	I_7
1	0	0	0	I_8
1	0	0	1	I_9
1	0	1	0	I_{10}
1	0	1	1	I_{11}
1	1	0	0	I_{12}
1	1	0	1	I_{13}
1	1	1	0	I_{14}
1	1	1	1	I_{15}

Differences: Multiplexer vs. Demultiplexer

Criteria	Multiplexer	Demultiplexer
Function	A MUX selects several input signals and transmits them on a single output line.	A DEMUX takes a single input signal and transmits it to one of several output lines.
Number of input lines	A MUX can have 'n' input lines, where 'n' can be any number.	A DEMUX typically has a single (1) input line.
Number of output lines	A MUX has log2 (n) output lines rounded up to the next integer value.	A DEMUX has n output lines, where 'n' can be any number.
Selection inputs	A MUX has selection inputs used to select one of the input lines for transmission to the output line.	A DEMUX has selection inputs used to select which output line the input signal should be transmitted through.
Example	A MUX is used for selecting one of several video inputs to display on a TV.	A DEMUX is used for distributing a digital signal to multiple devices.
Applications	Multiplexers are used in data transmission, signal routing, memory addressing, computer networks, Data Selector and more.	Demultiplexers are used in memory decoding, signal routing, communication systems, computer networks, Data Distributor and more.