COMBINATIONAL LOGIC

MULTIPLEXER
DEMULTIPLEXERS

DIGITAL LOGIC DESIGN

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Multiplexer

★ Multiplexer is a combinational circuit that has 2^n input lines, n selection lines and a single output line. The select lines determine which input is connected to the output.

★ **Multiplexer a**lso known as a data selector.

★ Mux acts as an electronic switch.It Allows for conditional transfer of data.

★ MUX Types

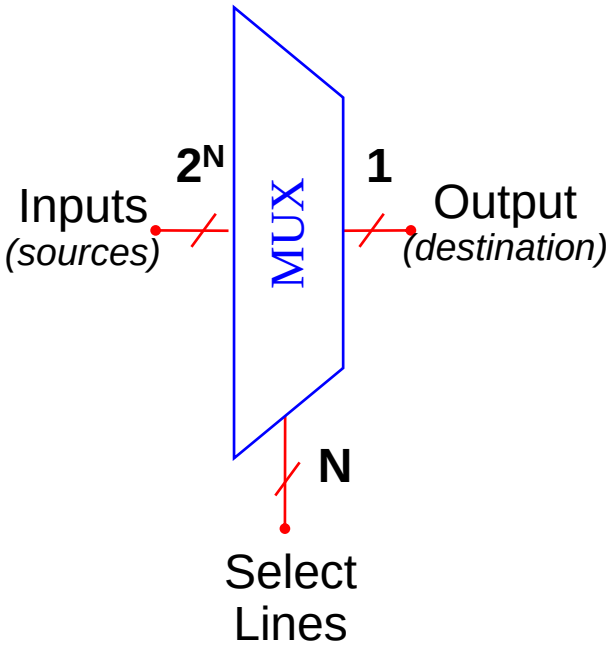
→ 2-to-1 (1 select line)

→ 4-to-1 (2 select lines)

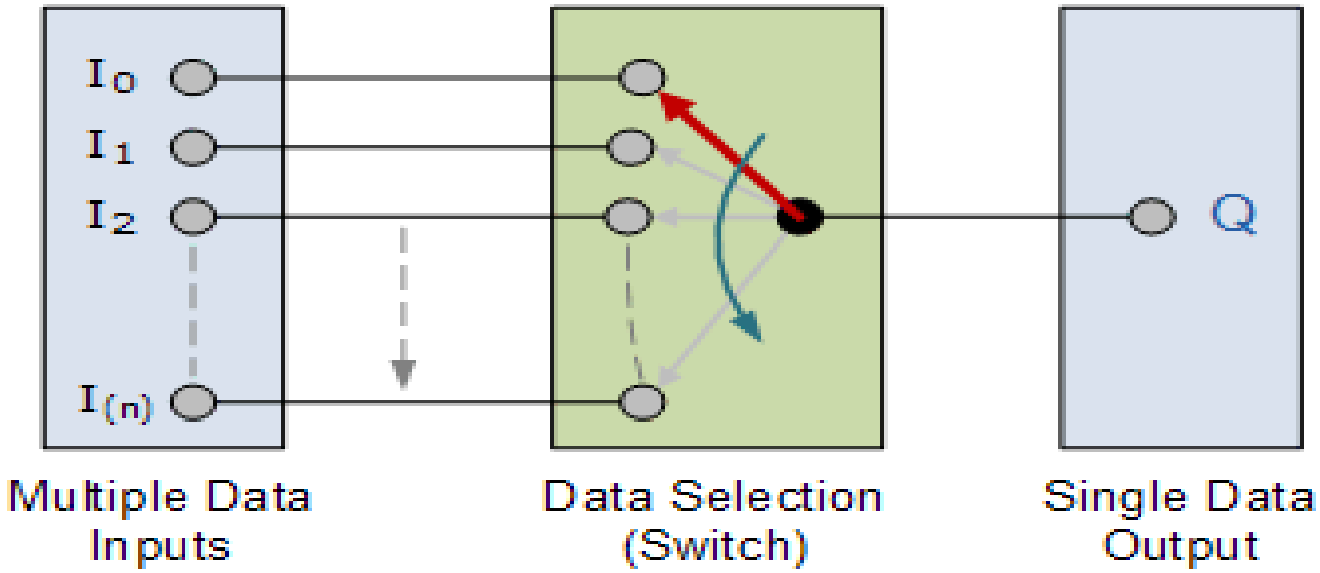
→ 8-to-1 (3 select lines)

→ 16-to-1 (4 select lines)

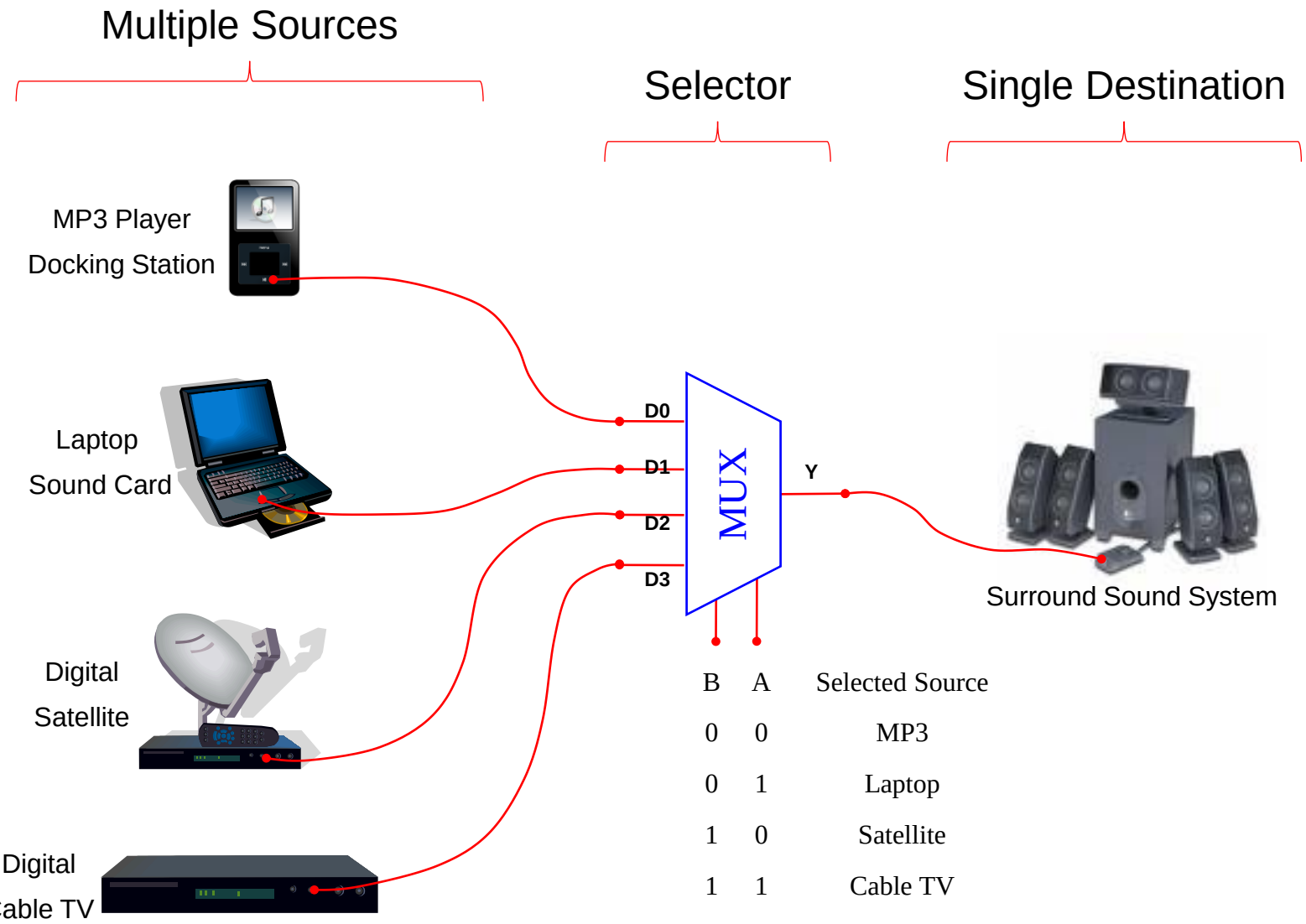
Multiplexer
Block Diagram



Multiplexers



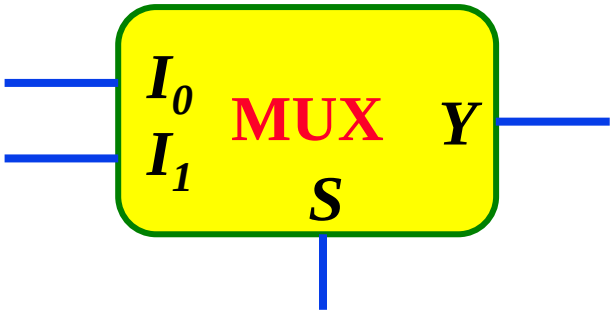
Typical Application of a MUX



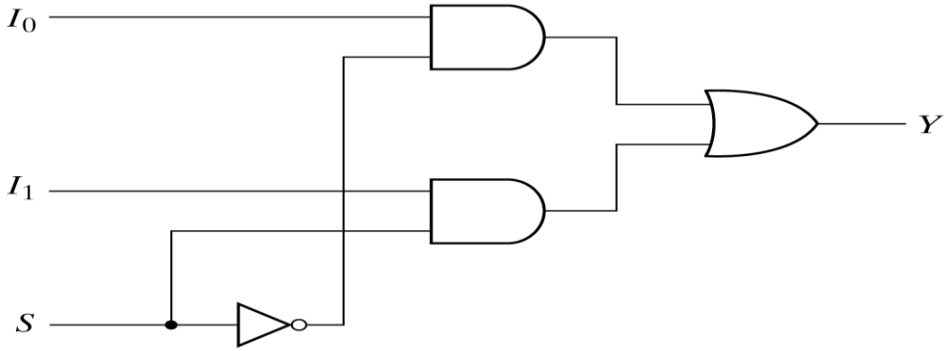
B	A	Selected Source
0	0	MP3
0	1	Laptop
1	0	Satellite
1	1	Cable TV

Multiplexers : 2-to-1 lines mux

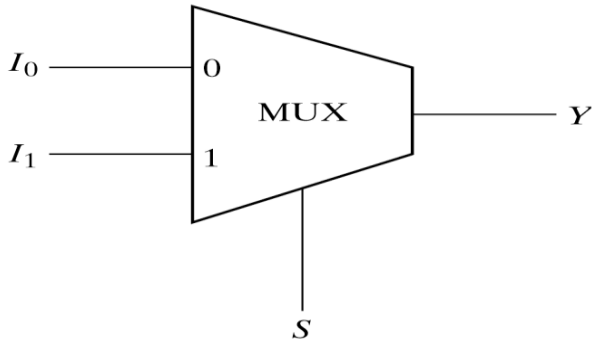
S_0	Y
0	I_0
1	I_1



$$Y=I_0\bar{S}_0+I_1S_0$$



(a) Logic diagram

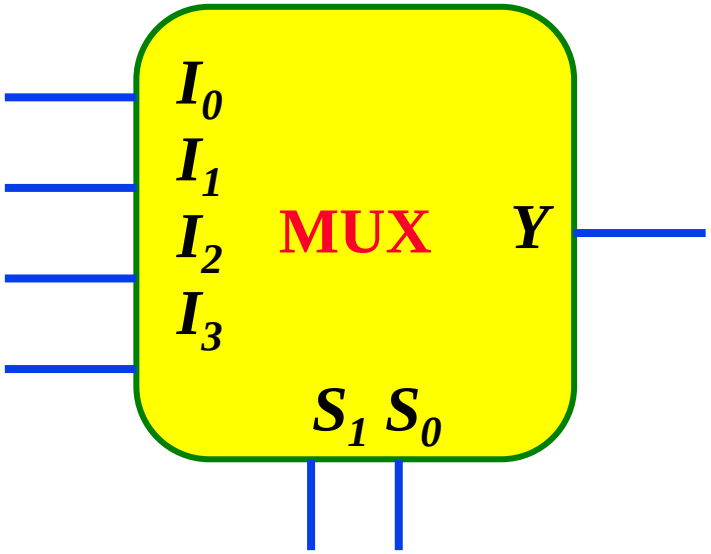


(b) Block diagram

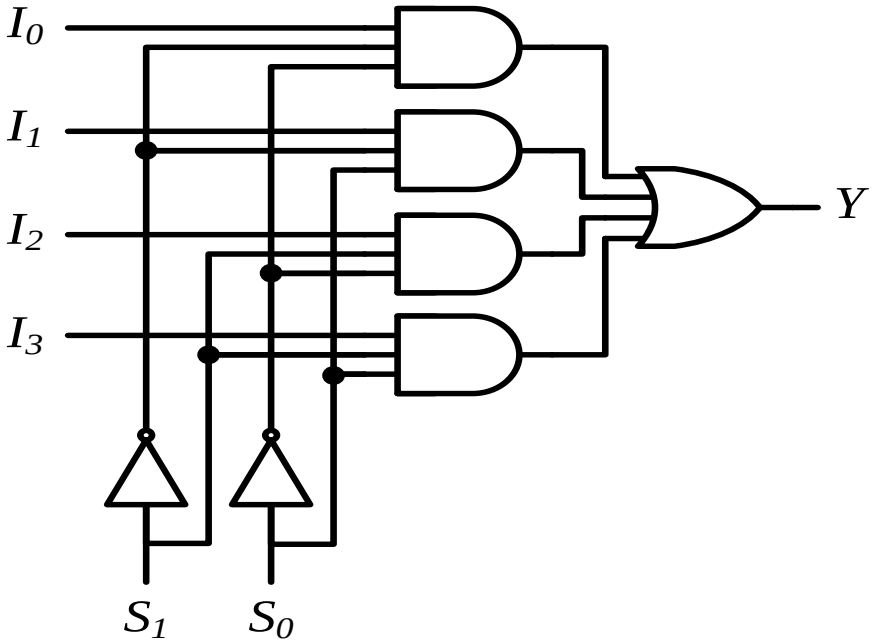
Fig. 4-24 2-to-1-Line Multiplexer

Multiplexers: 4 to 1 line mux

S_1	S_0	Y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

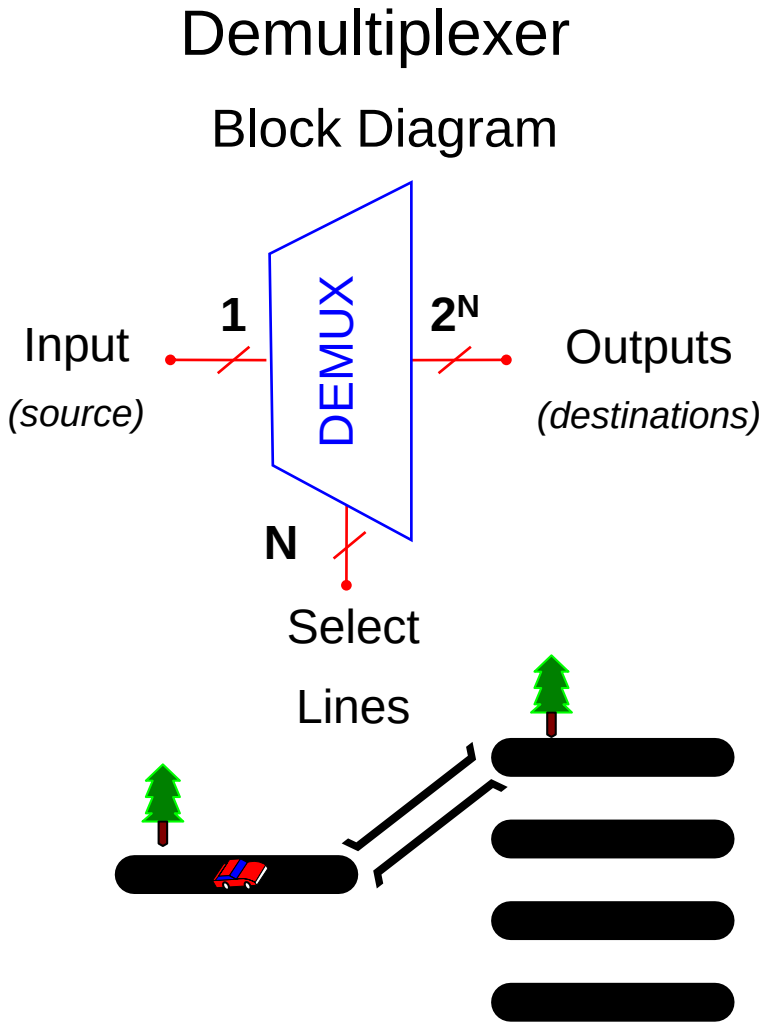


$$Y=I_0\bar{S}_1\bar{S}_0+I_1\bar{S}_1 S_0+I_2 S_1\bar{S}_0+I_3 S_1 S_0$$

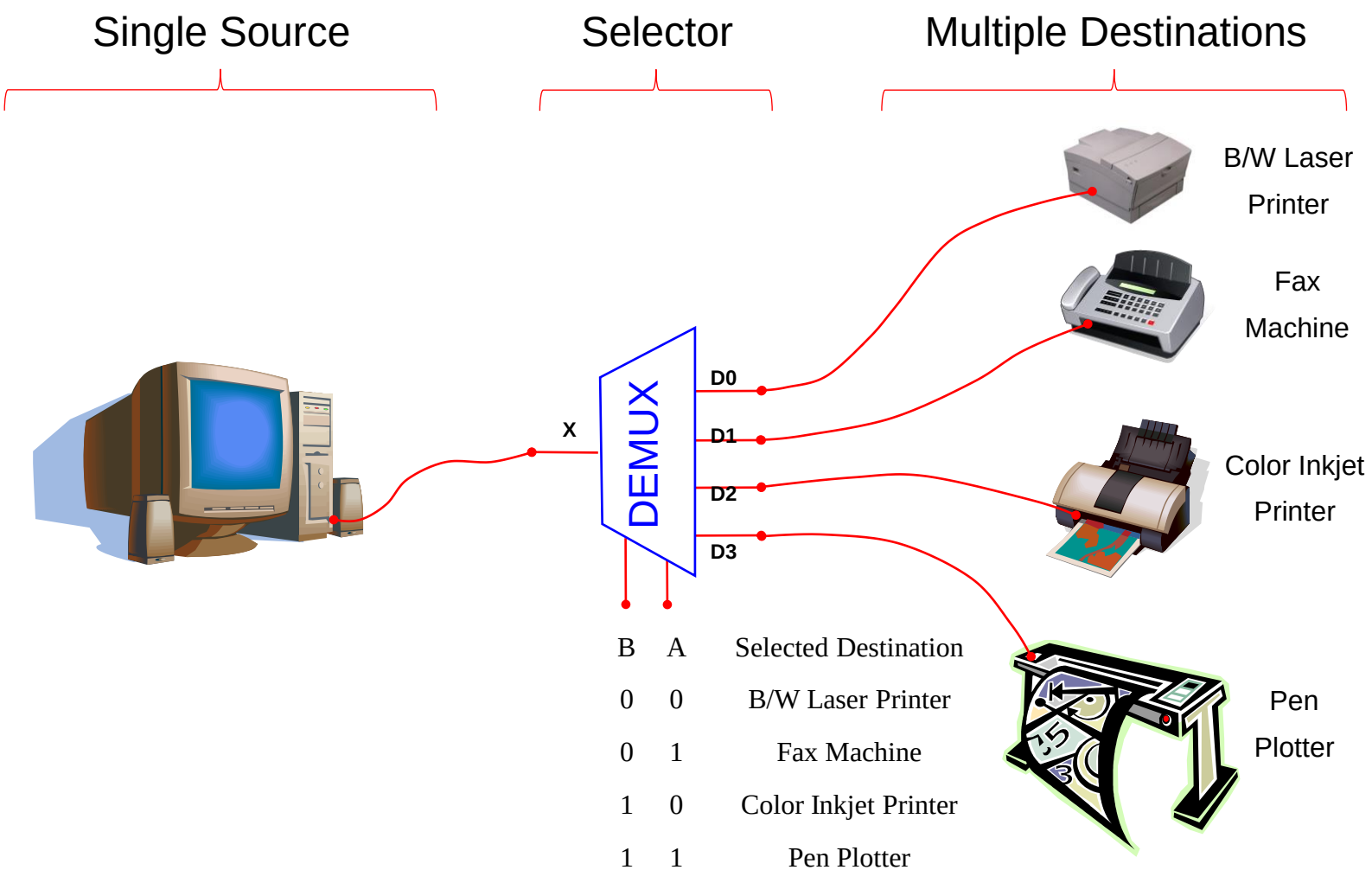


What is a Demultiplexer (DEMUX)?

- ★ Demux is a combinational circuit that has a single input lines, n selection lines and 2^n output line. The select lines determine which output the input is connected to.
- ★ **DEMUX Types**
  - → **1-to-2 (1 select line)**
  - → **1-to-4 (2 select lines)**
  - → **1-to-8 (3 select lines)**
  - → **1-to-16 (4 select lines)**



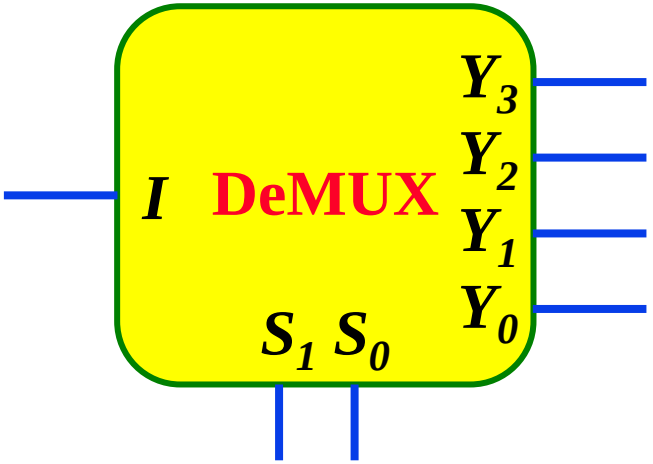
Typical Application of a DEMUX



B	A	Selected Destination
0	0	B/W Laser Printer
0	1	Fax Machine
1	0	Color Inkjet Printer
1	1	Pen Plotter

DeMultiplexers (1 to 4 lines demux)

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

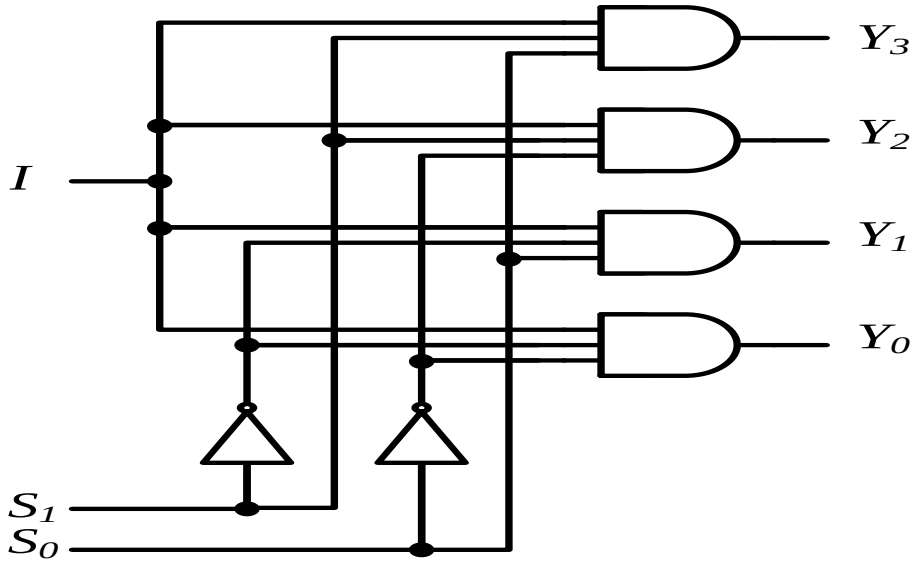


$Y_0 = I\bar{S}_1\,\bar{S}_0$

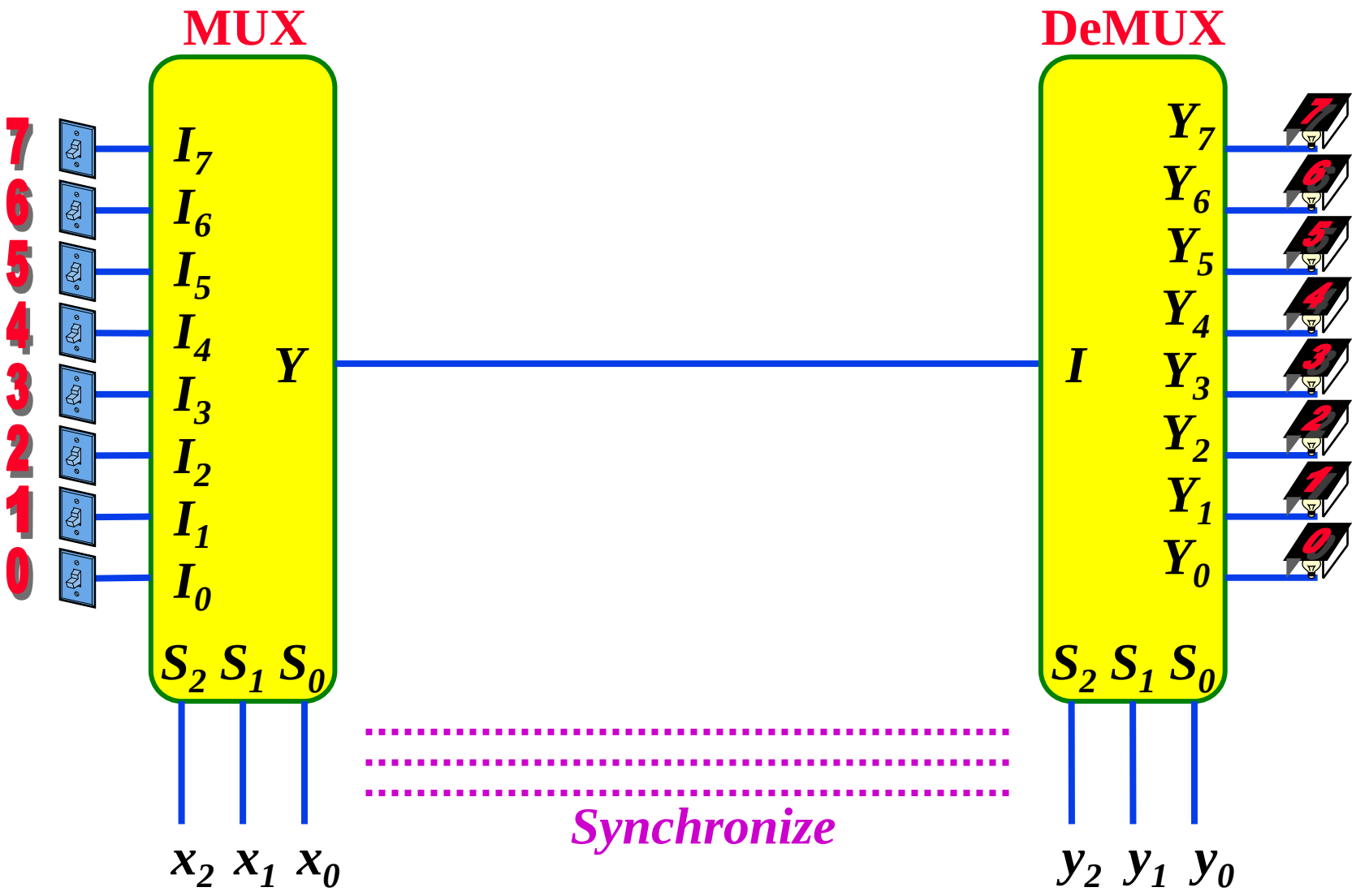
$Y_1 = I\bar{S}_1\,S_0$

$Y_2 = IS_1\,\bar{S}_0$

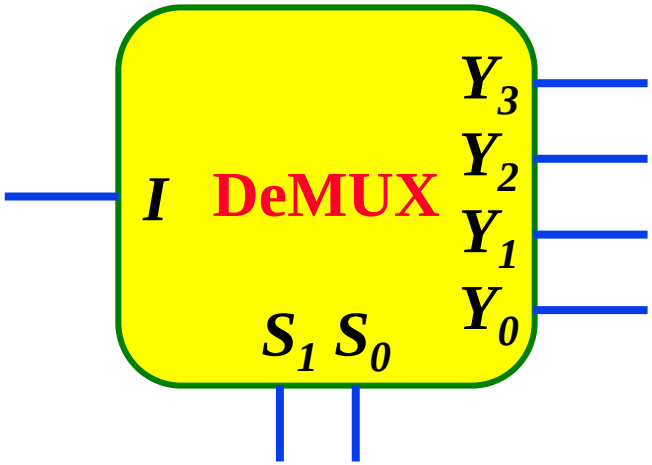
$Y_3 = IS_1\,S_0$

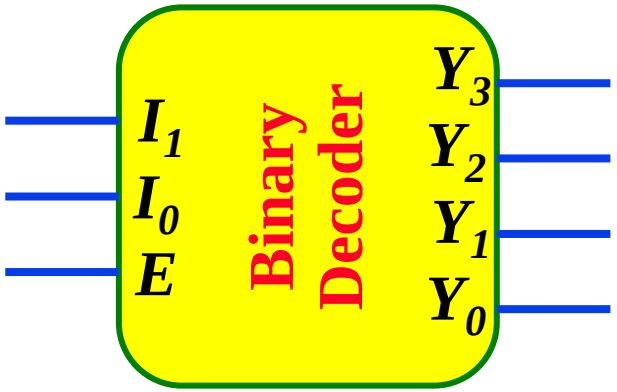


Multiplexer / DeMultiplexer Pairs



DeMultiplexers / Decoders



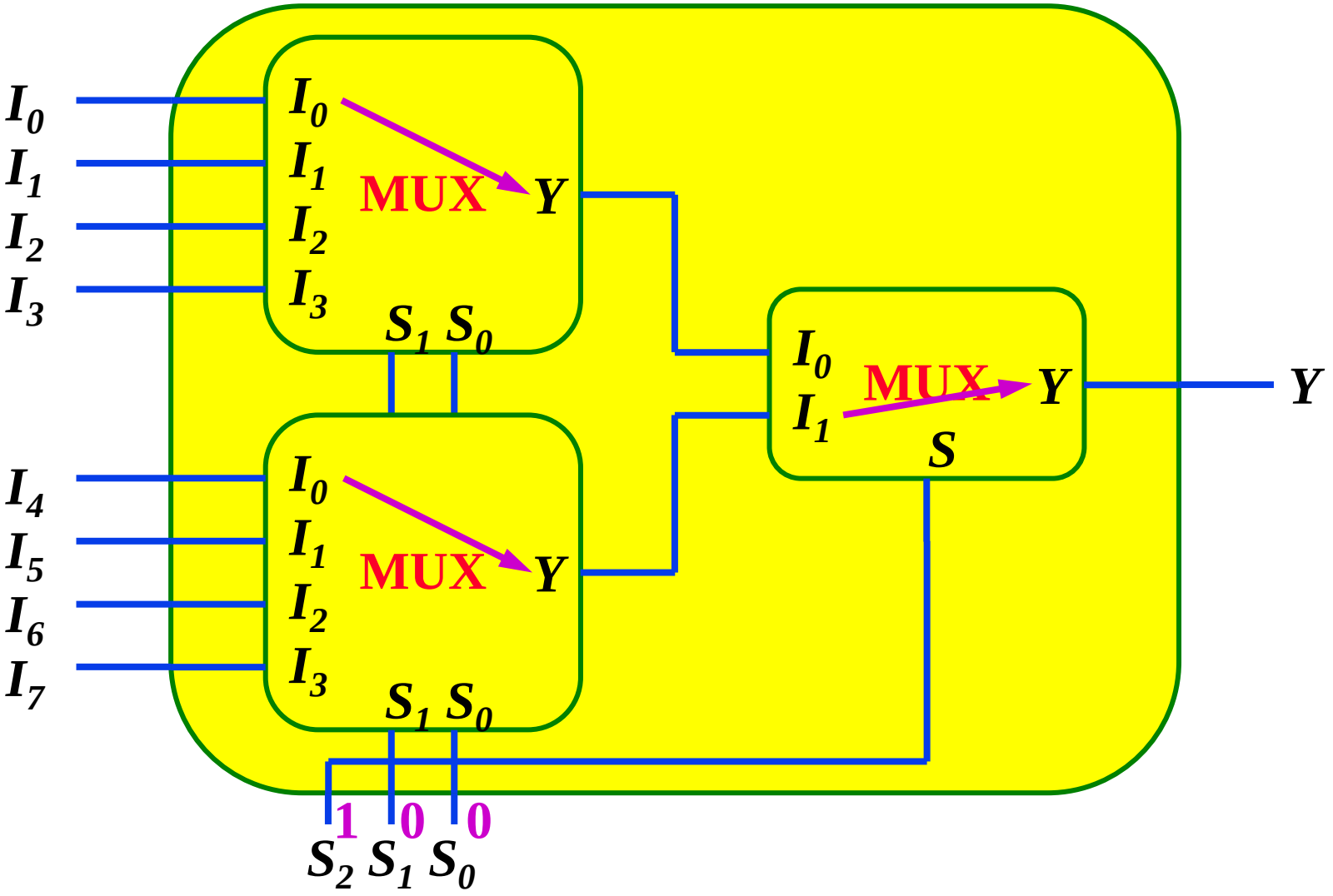


S_1	S_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	I
0	1	0	0	I	0
1	0	0	I	0	0
1	1	I	0	0	0

E	I_1	I_0	Y_3	Y_2	Y_1	Y_0
0	x	x	0	0	0	0
1	0	0	0	0	0	1
1	0	1	0	0	1	0
1	1	0	0	1	0	0
1	1	1	1	0	0	0

Multiplexer Expansion

★ 8-to-1 MUX using Dual 4-to-1 MUX and single 2-to-1 MUX



Motivation

★ **Design a single bit ALU**