AROR UNIVERSITY
OF ART, ARCHITECTURE,
DESIGN & HERITAGE,
SUKKUR, SINDH

Faculty of Artificial Intelligence & Multimedia Gamming

BS – Artificial Intelligence (Section A and B)

Digital Logic Design Lab

Lab # 09: Multiplexer and De-Multiplexer

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Submission Profile

Name: Submission date (dd/mm/yy):

Marks obtained:

Comments:

_____

Instructor

Lab Learning Objectives:

Upon successful completion of this experiment, the student will be able:

- Reflect on the similarities and differences between encoders and multiplexers
- Examine the function of a Multiplexer and De- Multiplexer using logic gates
-

Lab Hardware and Software Required:

Platform: NI ELVIS III	✔ View User Manual: http://www.ni.com/en-us/support/model.ni-elvis-iii.html ✔ View Tutorials: https://www.youtube.com/playlist?list=PLvcPIuVaUMIWm8ziaSxv0gwtshBA2dh_M
Software: NI Multisim 14.0.1 Education Version or newer	✔ Install Multisim: http://www.ni.com/gate/gb/GB_ACADEMICEVALMULTISIM/US ✔ View Help: http://www.ni.com/multisim/technical-resources/

Background Theory:

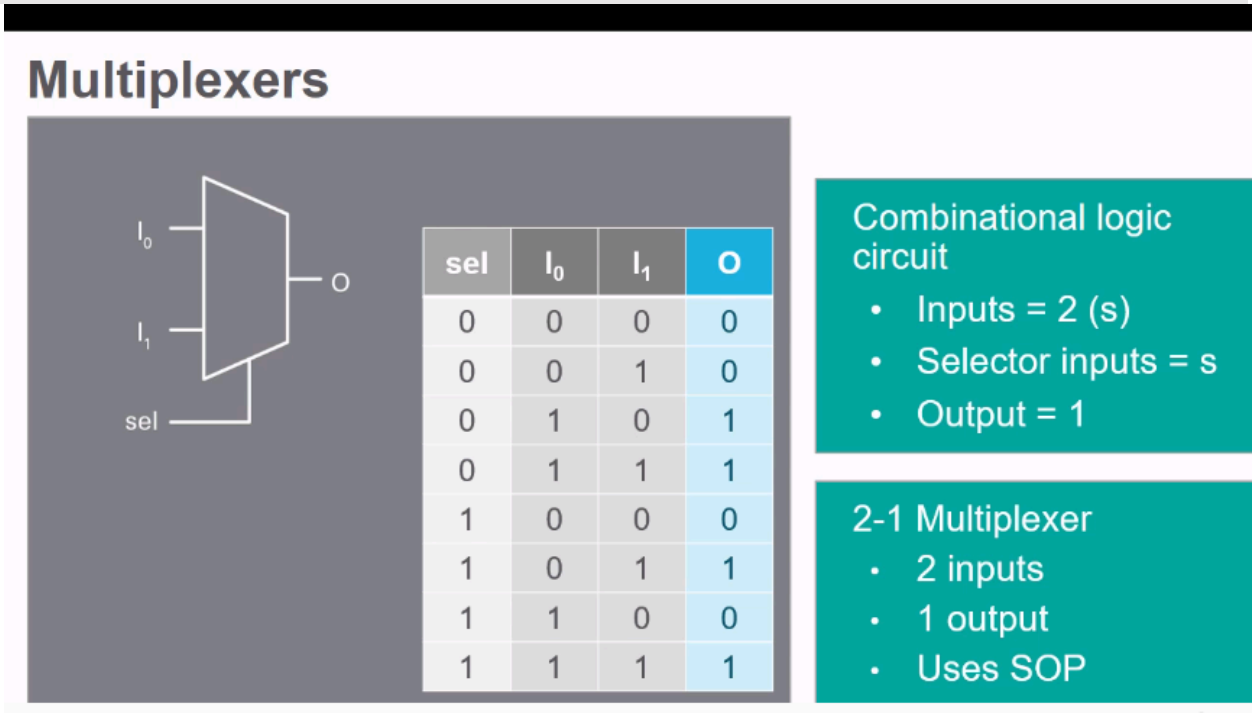


Figure 1-1 Video. View the video here: https://youtu.be/khmQ-LT_Cxg

Video Summary

- Multiplexers are combinational logic circuits
- Clock multiplexing is used for operating the same logic function at different clock rates from different sources
- Demultiplexers are combinational logic circuits that have the opposite function of a multiplexer

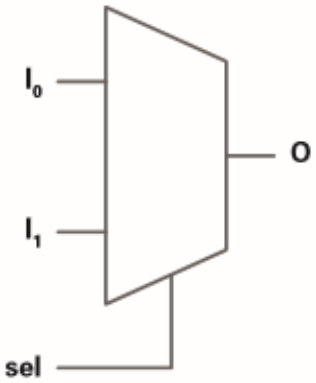
Multiplexers

The *multiplexer*, abbreviated *MUX*, is a combinational logic circuit which has multiple data inputs, one or more select inputs and one output.

- It passes the data on one of the inputs, depending on the selection signals, to the output
- With the help of this logic circuit, multiple signals can share the same data output
- Multiplexers have 2s inputs and s selector lines, which determine which of the inputs to output.
- Multiplexers are one of the most widely used combinational circuits, their application areas include:
    - Data routing
    - Operation sequencing

- Parallel-to-serial conversion
- Waveform generation

The simplest circuit is the 2-to-1 multiplexer, with the graphical symbol presented in the leftmost figure. Its functionality is described by the joining truth table. The multiplexer below is only 1-bit wide since bit line is connected to a single output bit line.



sel	I_0	I_1	O
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

Figure 1-2 Image of 2-to-1 multiplexer (left) and truth table (right)

The truth table can be simplified to the following truth table for a bitter understanding of the circuit's operation:

sel	O
0	I_0
1	I_1

Figure 1-3 Simplified truth table

Using the sum-of-products Boolean function gives the following combinational logic circuit:

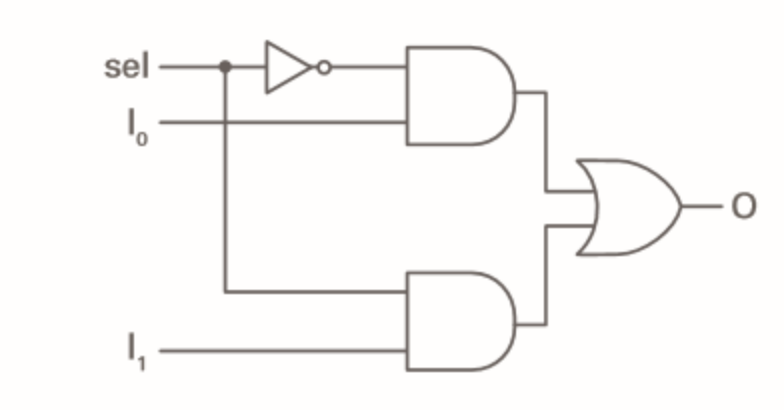


Figure 1-4 Combinational logic circuit

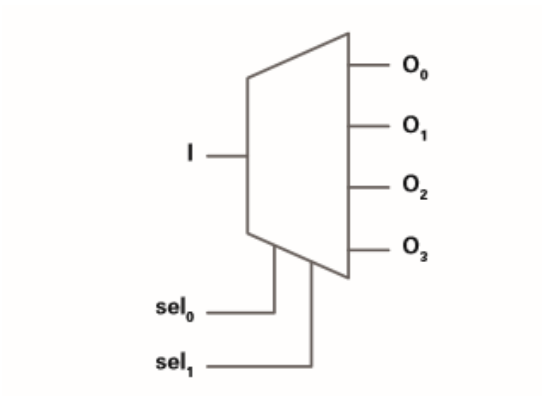
Clock multiplexing is a technique used for operating the same logic function at different clock rates, from different sources (inputs).

- The logic circuits are switched by the select signal often while the circuit is running
- This process of switching isn't very safe and can result in a glitch that occurs when one signal is going down as the other is going up.
- Clock safe switches can be implemented to eliminate glitches.

Demultiplexers

Demultiplexers (DEMUX) have the opposite function of a multiplexer

- It places the value of a single data input on several data outputs depending on a selection signal
- Usually demultiplexers have s select inputs and 2s outputs
- Since demultiplexers take one input and connect it to many outputs, some of their uses are for communication (two-way communication usually includes both multiplexers and demultiplexers) and for serial to parallel converters
- The graphical symbol for a 1-to-4 demultiplexer is shown below (left) as well as the corresponding 1-to-4 DEMUX truth table (centre) and the CLC (right)



sel_1	sel_0	O_3	O_2	O_1	O_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

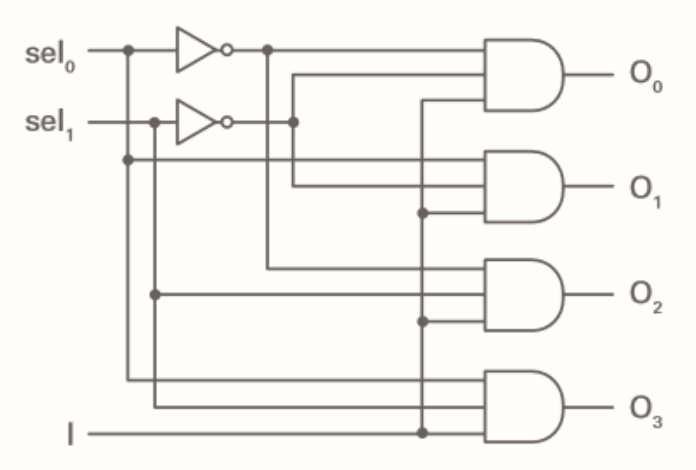


Figure 1-5 Demultiplexer (top left), truth table (top center) and CLC (bottom)

1-1 Write the sum-of-products Boolean functions for the 2-to-1 Multiplexer:

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1-2 Write the sum-of-products Boolean functions for the 1-to-4 Demultiplexer:

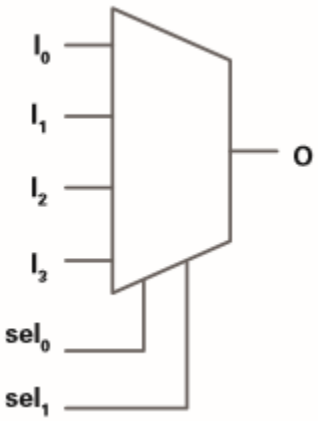
1-3 What is the function of the Selector (Sel) in Multiplexers and Demultiplexers?

- Use a Venn diagram to show the similarities and differences between Encoders and Multiplexers. Add the file, picture, or a screenshot of the Venn diagram to your completed lab.

Lab Activities:

4-to-1 MUX

Using the following truth table (right) to describe the behavior of a 4-to-1 MUX (left), design and implement the corresponding circuit in multisim.



sel_1	sel_0	O
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

Figure 1-8 Image of 4-to-1 MUX (left) and truth table (right)

1-to-4 Demultiplexer

In simulation build and run the following 1-to-4 demultiplexer

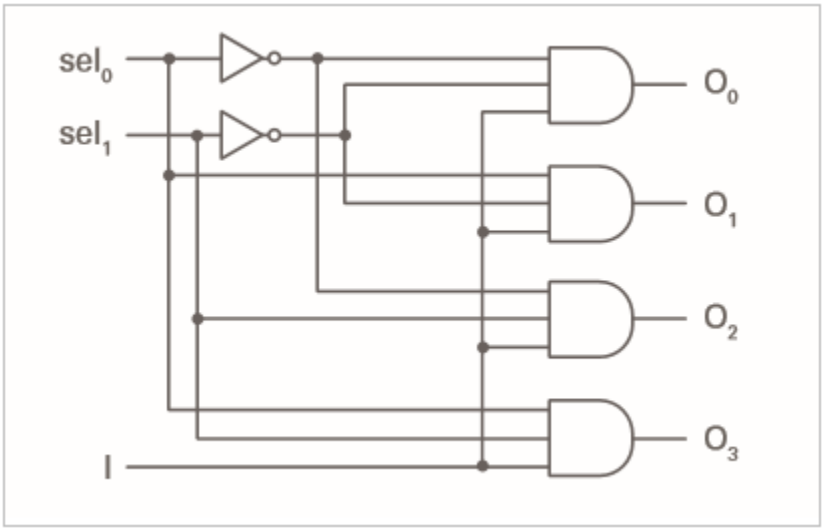


Figure 1-9 Image of 1-to-4 demultiplexer

Lab Exercise:

- Implement 4 to 1 multiplexer circuit on **NI-ELVIS II** using 74HC153/74LS153

- Implement 1 to 4 de-multiplexer circuit on **NI-ELVIS II** using 74HC155/74LS155

- Implement 8 to 1 multiplexer by cascading two 74HC153/74LS153

Conclusion:

1-4 In an everyday application, when would a multiplexer be useful?

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1-5 In an everyday application, when would a demultiplexer be useful?

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1-6 How many outputs does a multiplexer have?

A. 1
B. 2
C. 3
D. 2^n

1-7 Why can the truth table of a 2-to-1 multiplexer be simplified depending on whether the selector is set to 0 or 1?

A. There is only one output
B. Some of the outputs of the original truth table are don't care conditions
C. The line that is selected to be inputted will be the only one affecting the output
D. None of the above

1-8 The 1-to-4 demultiplexer has how many selectors?

A. 4
B. 3
C. 2
D. None of the above

1-9 What is the difference between the logic circuit of a 2-to-4 decoder and a 1-to-4 demultiplexer?

A. They use a different combination of logic gates
B. They have a different number of outputs
C. They have different inputs
D. All of the above