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)

Typical Application of a MUX

- Multiple Sources
- Selector
- Single Destination
4-to-1 Multiplexer (MUX)

<table>
<thead>
<tr>
<th>B</th>
<th>A</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>D0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>D1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>D2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>D3</td>
</tr>
</tbody>
</table>

4-to-1 Multiplexer Waveforms

What is a Demultiplexer (DEMUX)?

- A DEMUX is a digital switch with a single input (source) and a multiple outputs (destinations).
- 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

1-to-4 De-Multiplexer (DEMUX)

1-to-4 De-Multiplexer Waveforms

Medium Scale Integration DEMUX

Note: Most Medium Scale Integrated (MSI) DEMUXs, like the three shown, have outputs that are inverted. This is done because it requires few logic gates to implement DEMUXs with inverted outputs rather than no-inverted outputs.
Seeing Is NOT Always Believing

- Our lives are filled with electronic signs that display the time, temperature, or ball game score. However, what we see is not always what is really happening.
- In fact for most displays, the individual display segments are cycled through so that only one display is on at any given time.
- The cycle speed is so fast that the human eye perceives that all segments are on.

Simple Message: All Segments On

- The circuit to the right uses four 7-segment displays to display the word CIAO. In this circuit all displays are continuously illuminated, each displaying one letter in the word.
- Though this method works, it is a VERY inefficient use of power. To illuminate the simple message CIAO in this way, 18 segments must be continuously on.
- Can you think of another way to display this message that would use less power?

Multiplexed Displays Segments

- In this circuit the display segments are multiplexed, meaning that only one display is on at a time.
- To display the entire word, the displays must be de-multiplexed using a 1-to-4 DEMUX.
- In this example the select lines that control the DEMUX are connected to two switches. You must toggle 00, 01, 10, 11 to see the entire message.

Let's See How It Works

Click Schematic to Play Video
This is a ripple counter (remember the dice game). We will learn how to design a ripple counter in unit 3.