

Peter Anthony

Michael Cavins

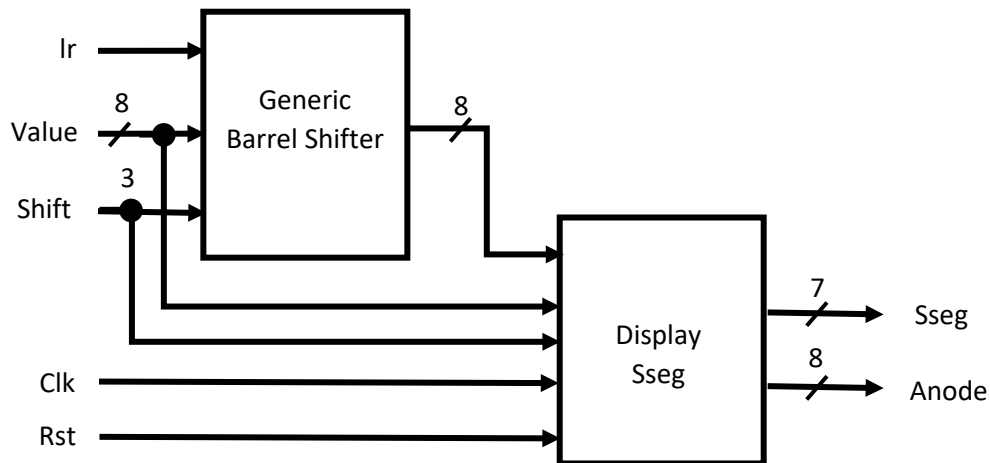
Andres Colon

ECE 4304 – 01

Lab 6: Generic Barrel Shifter

Architecture:

The objective of this lab was to create a barrel shifter that can rotate left and right. The shifter uses a generic parameter so that it can be utilized for any number of desired bits. The input values are a set of bits for the word, shift amount, and left/right select. The output of the barrel shifter is the newly shifted value. In the top file it takes in switches from the board and can output to both Ssegs and LEDs.



Tricks of the code:

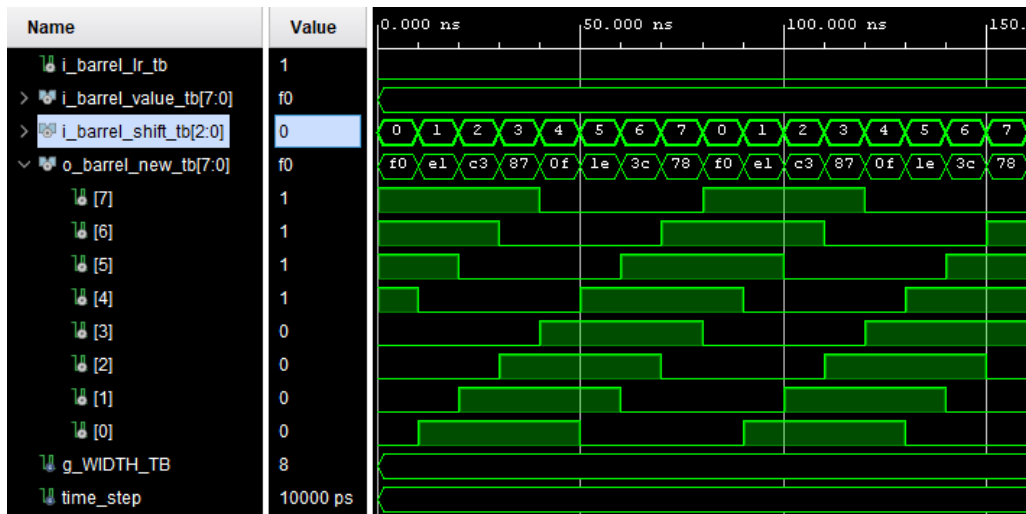
The main trick of this code is the algorithm for shifting both left and right. Below is the shift right, each stage generates a mux where the select is a shift bit for each stage. When the bit is '0' just pass the previous stage's value. If the bit is '1' then shift by 2^{stage} where stage is the level it is on. For example in an 8 bit word, there are 3 stages to control it. The first stage shifts by 1 bit, the second by 2 bits, and the third by 4 bits.

```
temp_shift_right(0) <= i_right_value;           -- Set the first stage to the input value
temp_shift          <= i_right_shift;           -- Assign the shift amount
o_right_new         <= temp_shift_right(shift_bits); -- Output the final shifted stage

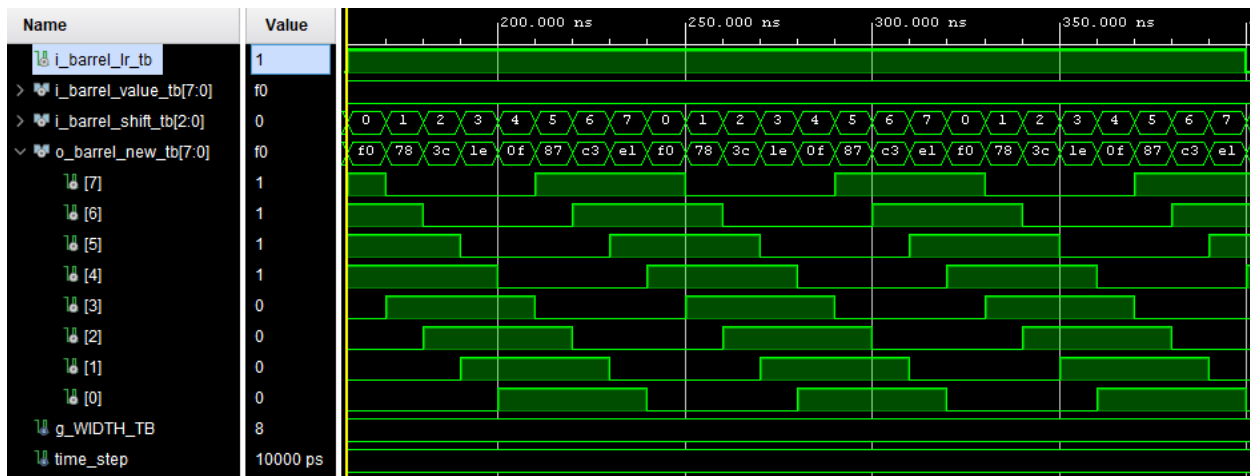
-- Generate the stages for the desired word width
GEN_STAGES_RIGHT: for i in 0 to shift_bits - 1 generate
  -- Process for each stage of muxes
  p_RIGHT_SHIFT: process(temp_shift, temp_shift_right)
  begin
    if(temp_shift(i) = '0') then -- When the current shift bit is 0 pass the previous value
      temp_shift_right(i + 1) <= temp_shift_right(i);
    else -- If the the current shift bit is 1 shift to the right by 2**shift_bit amount
      temp_shift_right(i + 1) <= temp_shift_right(i) (2**i - 1 downto 0) & temp_shift_right(i) (g_WIDTH_RIGHT - 1 downto 2**i);
    end if;
  end process;
end generate;
```

Testbench:

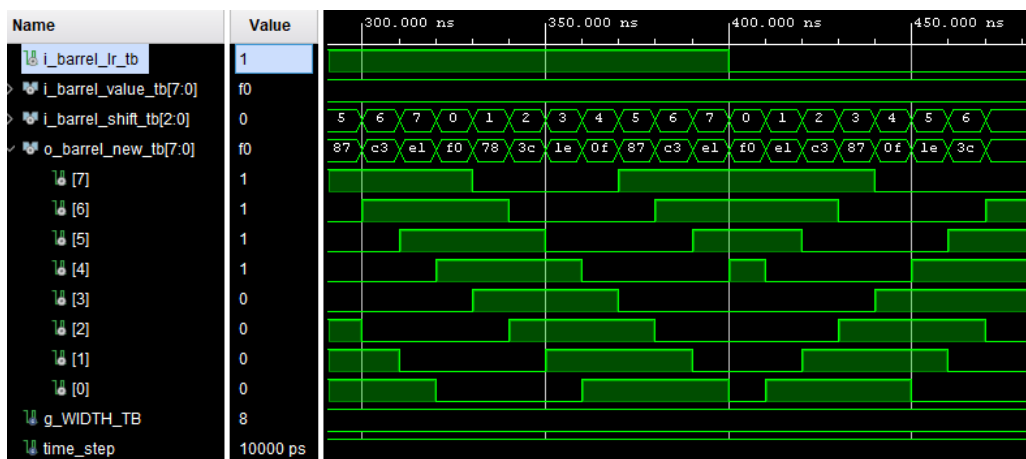
Shift Left



Shift Right



Switching between shift direction



Area/Resources:

Barrel Shifter Entity– 8 Bit

Name	Constraints	Status	WNS	TNS	WHS	THS	TPWS	Total Power	Failed Routes	LUT	FF	BRAM	URAM	DSP
✓ synth_1	constrs_1	synth_design Complete!								24	0	0.0	0	0
✓ impl_1	constrs_1	route_design Complete!	NA	NA	NA	NA	NA	4.734	0	24	0	0.0	0	0

Barrel Shifter Entity – 16 Bit

Name	Constraints	Status	WNS	TNS	WHS	THS	TPWS	Total Power	Failed Routes	LUT	FF	BRAM	URAM	DSP
✓ synth_1	constrs_1	synth_design Complete!								64	0	0.0	0	0
✓ impl_1	constrs_1	route_design Complete!	NA	NA	NA	NA	NA	10.563	0	64	0	0.0	0	0

Barrel Shifter Entity – 32 Bit

Name	Constraints	Status	WNS	TNS	WHS	THS	TPWS	Total Power	Failed Routes	LUT	FF	BRAM	URAM	DSP
✓ synth_1	constrs_1	synth_design Complete!								160	0	0.0	0	0
✓ impl_1	constrs_1	route_design Complete!	NA	NA	NA	NA	NA	23.661	0	160	0	0.0	0	0

Top Design

Name	Constraints	Status	WNS	TNS	WHS	THS	TPWS	Total Power	Failed Routes	LUT	FF	BRAM	URAM	DSP
✓ synth_1	constrs_1	synth_design Complete!								61	17	0.0	0	0
✓ impl_1	constrs_1	write_bitstream Complete!	7.551	0.000	0.324	0.000	0.000	0.121	0	61	17	0.0	0	0