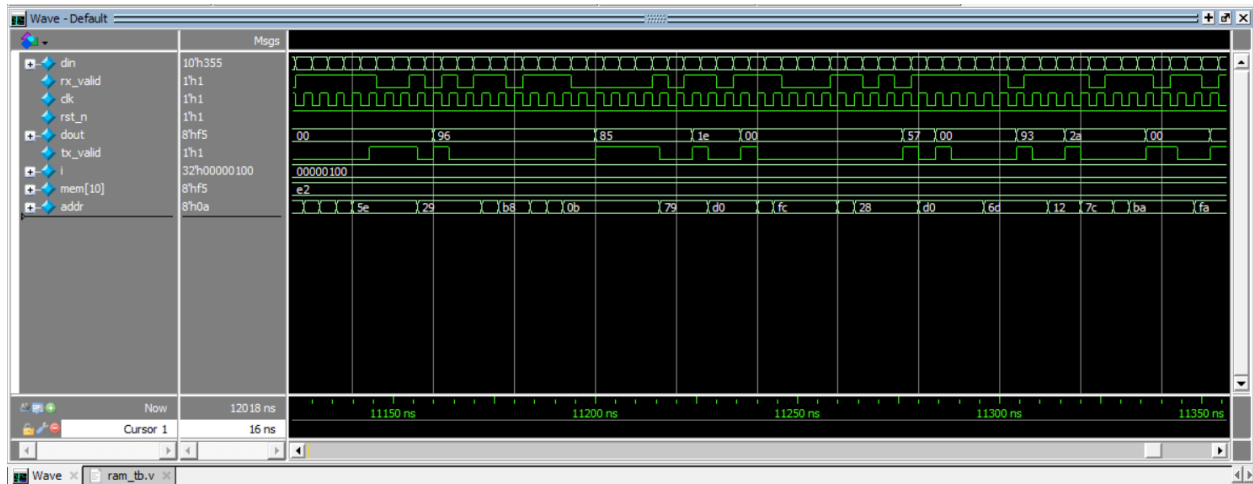
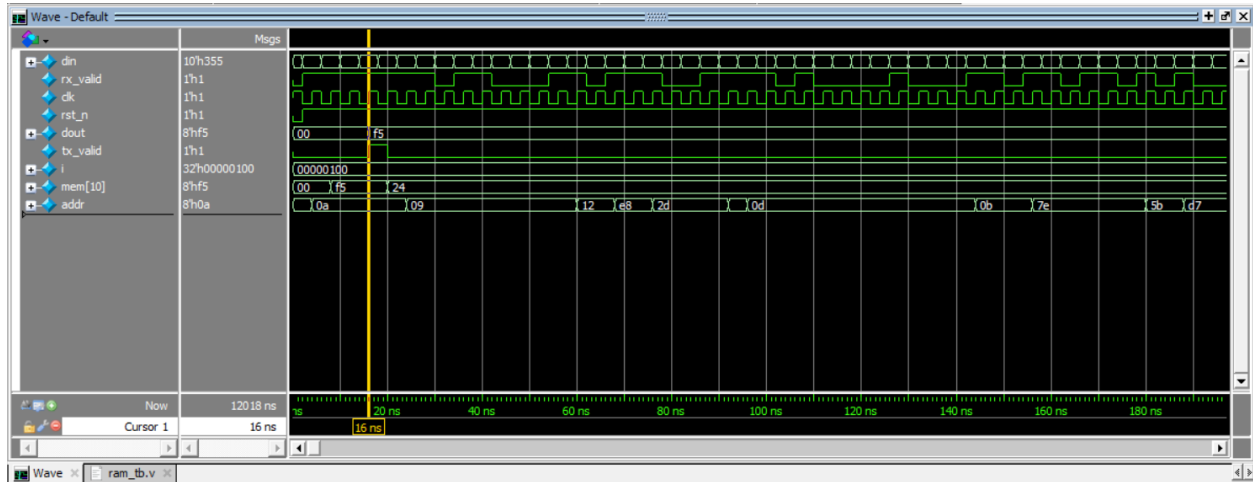


SPI Slave Interface Project

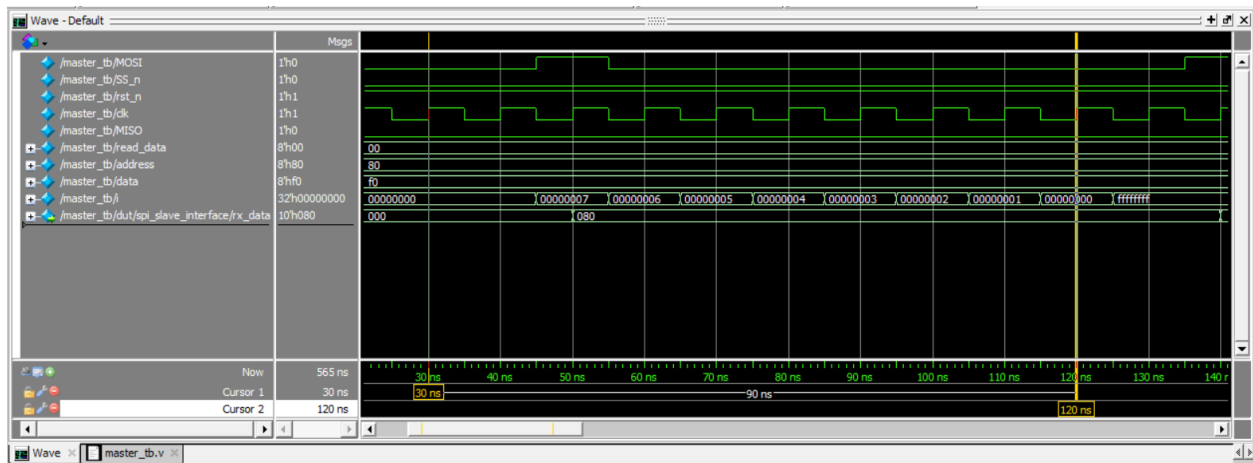
- QuestaSim Waveform

RAM testbench:

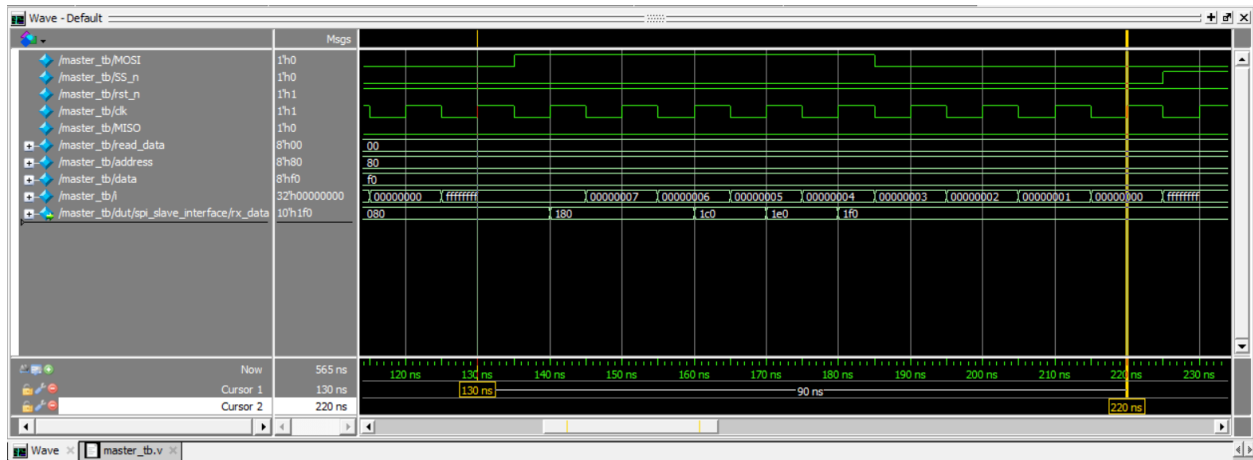


Master testbench 1:

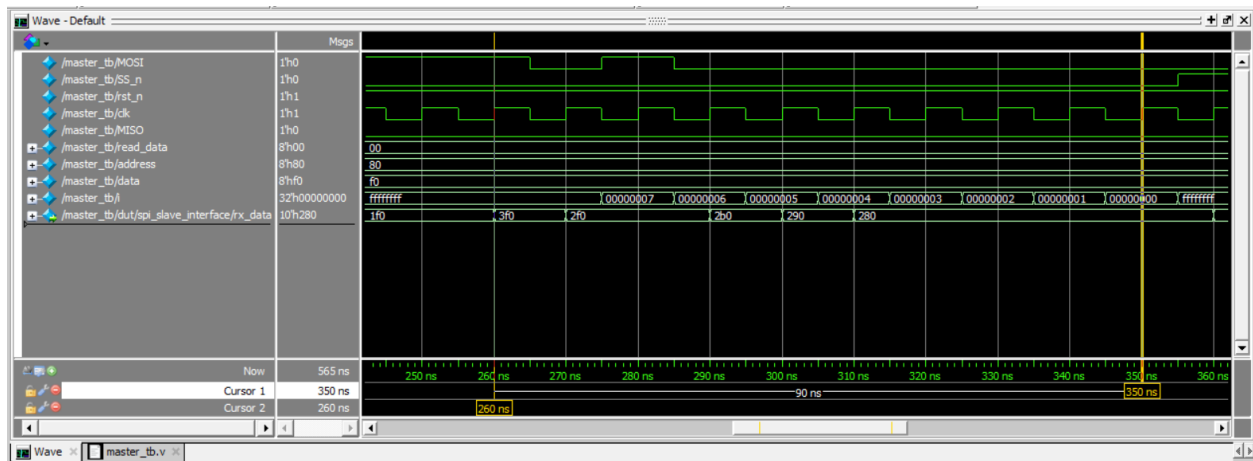
Write address: 8'b1000_0000



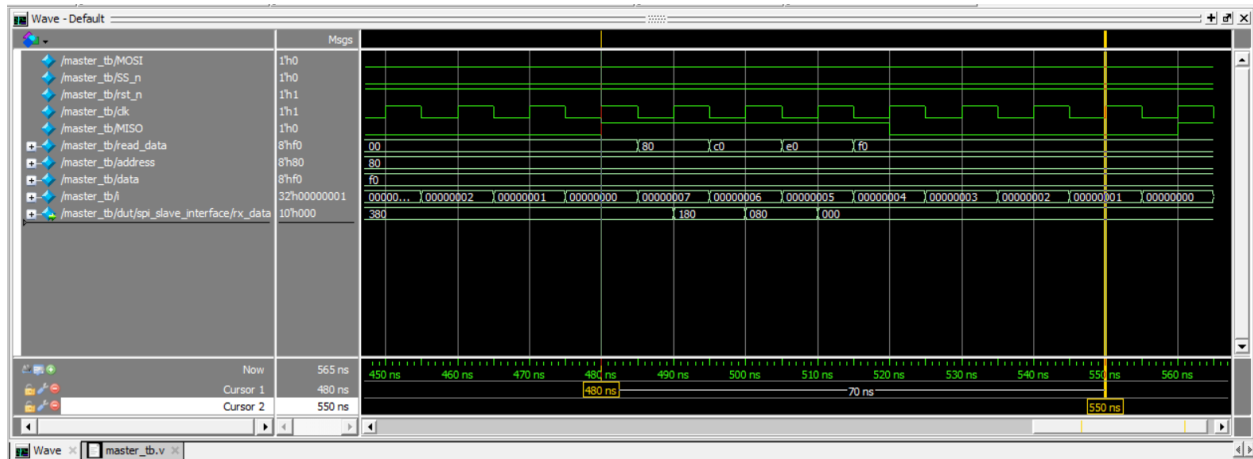
Write data: 8'hf0



Read address: 8'b1000_0000



Read data: 8'hf0



- QuestaLint

Warning is waived because serial_to_parallel_count = 9 and parallel_to_serial_count = 8 will not happen at the same time

QuestaLint 2021.1 (E:\digital_design_diploma\my_assig_answers\project2\lint.db)

File Edit View Lint Checks Window Help

Flow Navigator

- project
 - Add Sources
 - Methodology
 - Add Directives
 - Project Settings
 - Project Summary
 - Lint Analysis
 - Compile Design
 - Run Lint Analysis

E:\digital_design_diploma\my_assig_answers\project2\spi_slave.v [spi_wrapper.spi_slave_interface]

```

134   end
135   if(tx_valid) begin
136     data_received <= tx_data;
137     if(serial_to_parallel_count == 9)
138       received <= 1;
139   end
140   if(received) begin
141     MISO <= data_received [7 - parallel_to_serial_count];
142     parallel_to_serial_count = parallel_to_serial_count + 1;
143     if(parallel_to_serial_count == 8) begin
144       received <= 0;
145       parallel_to_serial_count <= 0;
146     end
147   end
148   addr_b4_data <= 0;
149 end
150 default: begin
151   addr_b4_data <= 0;
152   received <= 0;

```

Lint Summary

(Type Search Text (Press Enter))

Name	Count
Open/uninspected, pending	8 (9)
Info	8 (9)
Resolved/verified, fixed, ...	1
Warning	1
seq_block_has_duplicate...	1

Lint Checks

Filter: Type here

Severity	Status	Check	Alias	Message	Module	Category	State	Owner	STARC Reference
Warning	Resolved	seq_block_has_duplicate...		Signal is assigned more than once in a sequential bloc...	spi_slave	Rtl Design Style	resolved	unassign...	2.2.3.3

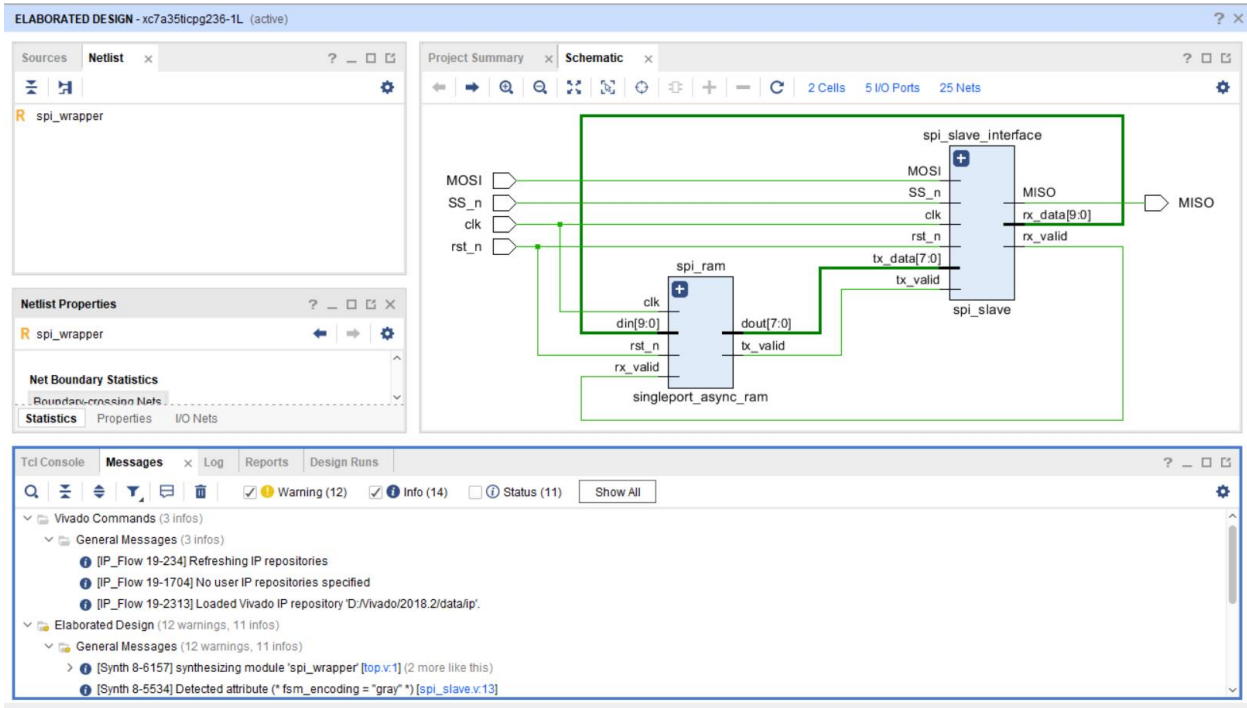
Transcript Message Viewer Lint Checks Design Metrics Design Information Status History Lint Dashboard

E:\digital_design_diploma\my_assig_answers\project2\spi_slave.v [spi_wrapper.spi_slave_interface]

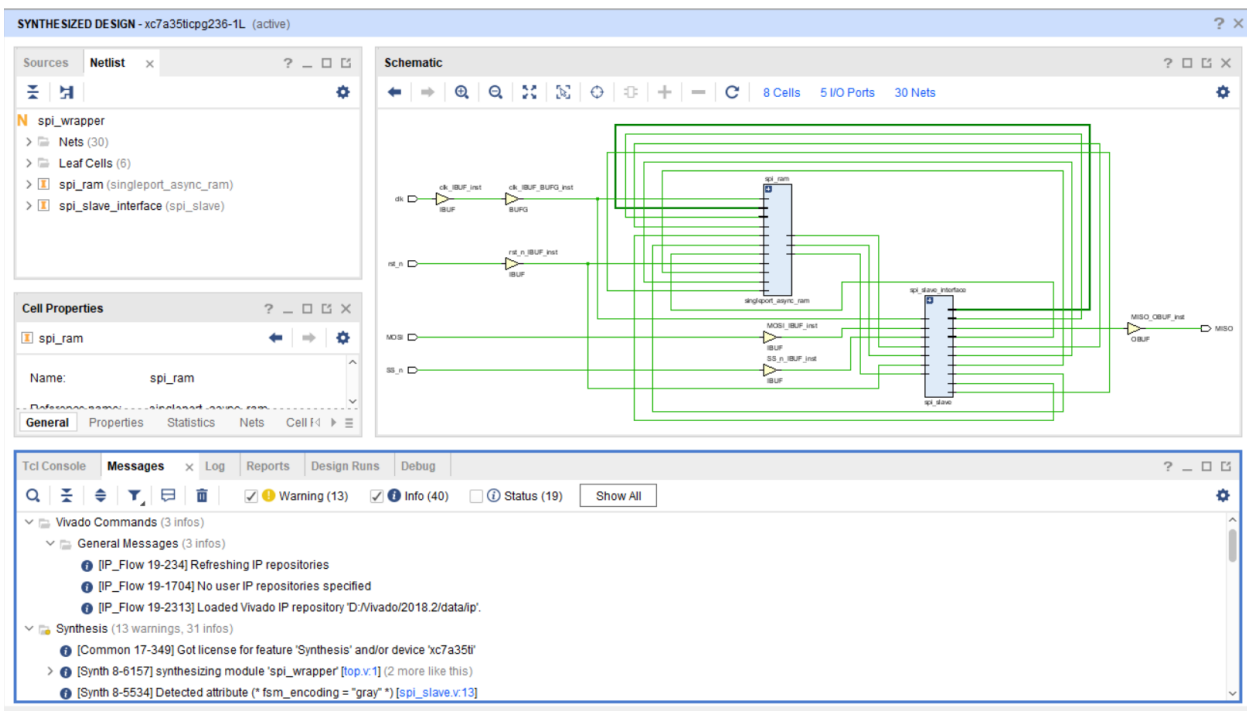
Synthesis tool

For gray encoding

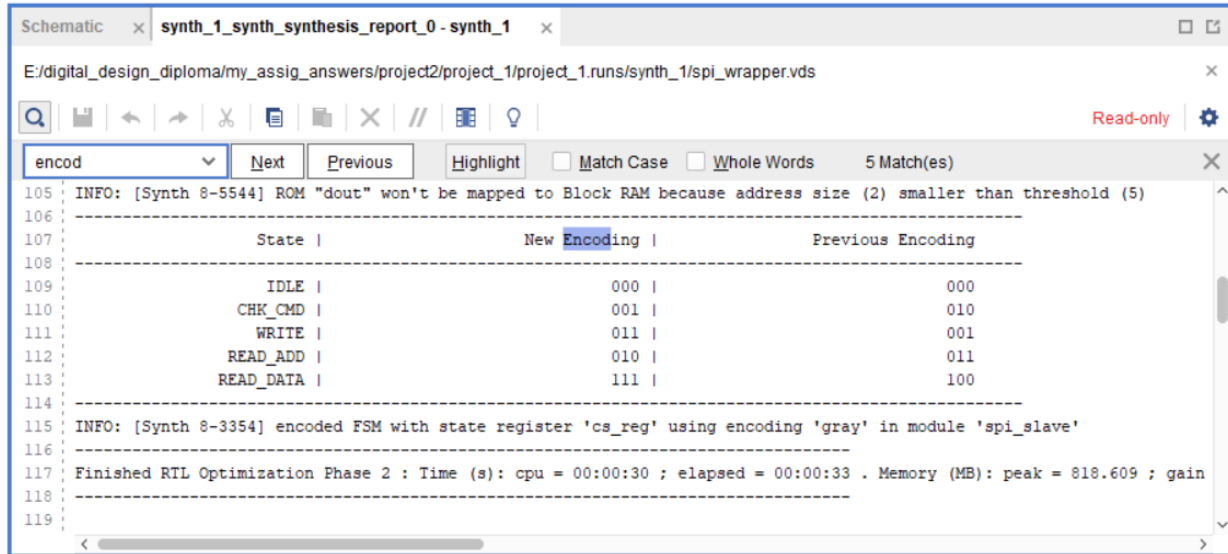
Elaboration:



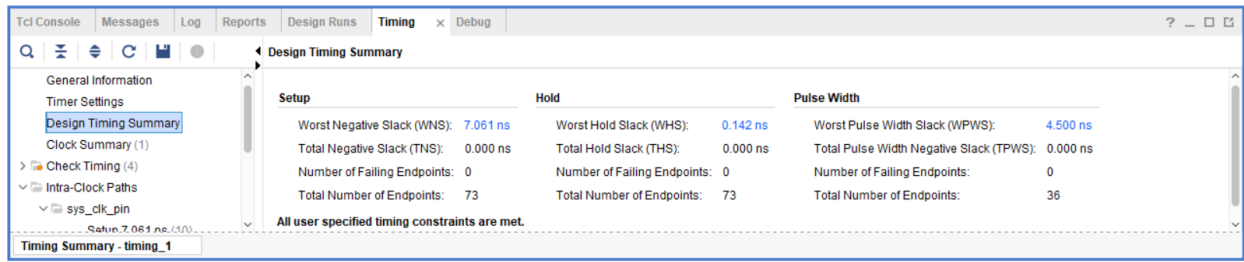
Synthesis



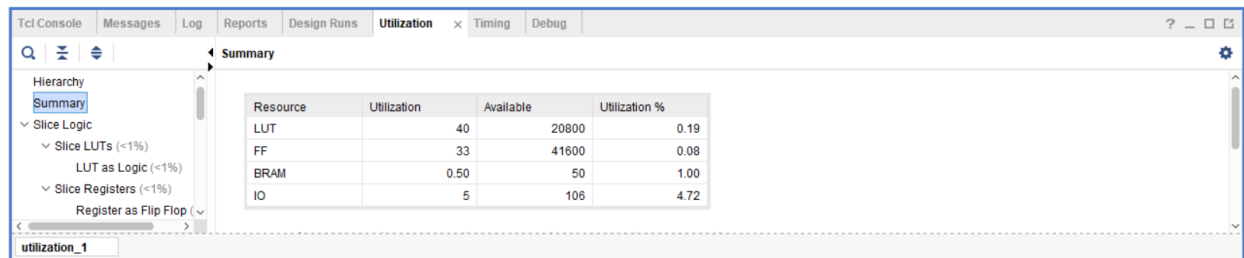
Synthesis report



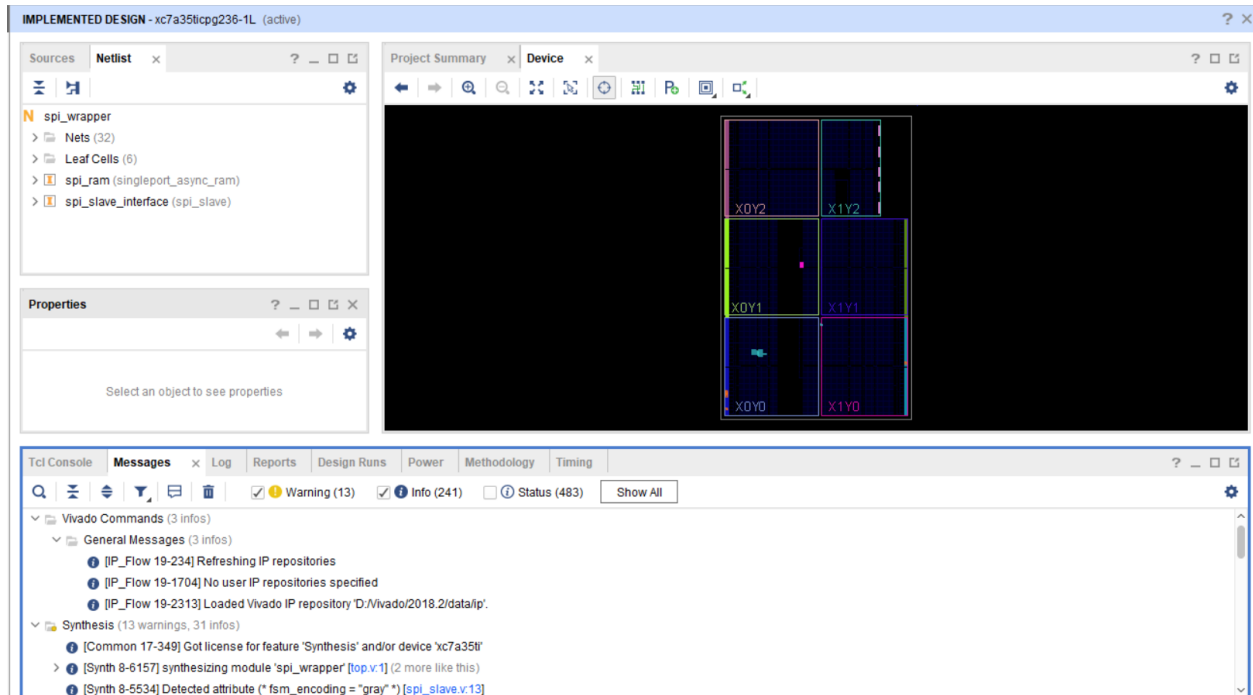
Timing report



Utilization



Implementation



Timing report

Tcl Console Messages Log Reports Design Runs Power Methodology Timing x ? _ □ □

Design Timing Summary

General Information

Timer Settings

Design Timing Summary

Clock Summary (1)

Check Timing (4)

Intra-Clock Paths

Inter-Clock Paths

Other Path Groups

Timing Summary - impl_1 (saved) x Timing Summary - timing_1 x

Setup	Hold	Pulse Width
Worst Negative Slack (WNS): 7.089 ns	Worst Hold Slack (WHS): 0.059 ns	Worst Pulse Width Slack (WPWS): 4.500 ns
Total Negative Slack (TNS): 0.000 ns	Total Hold Slack (THS): 0.000 ns	Total Pulse Width Negative Slack (TPWS): 0.000 ns
Number of Failing Endpoints: 0	Number of Failing Endpoints: 0	Number of Failing Endpoints: 0
Total Number of Endpoints: 73	Total Number of Endpoints: 73	Total Number of Endpoints: 36

All user specified timing constraints are met.

Utilization

Tcl Console Messages Log Reports Design Runs Power Methodology Timing Utilization x ? _ □ □

Summary

Hierarchy

Summary

Slice Logic

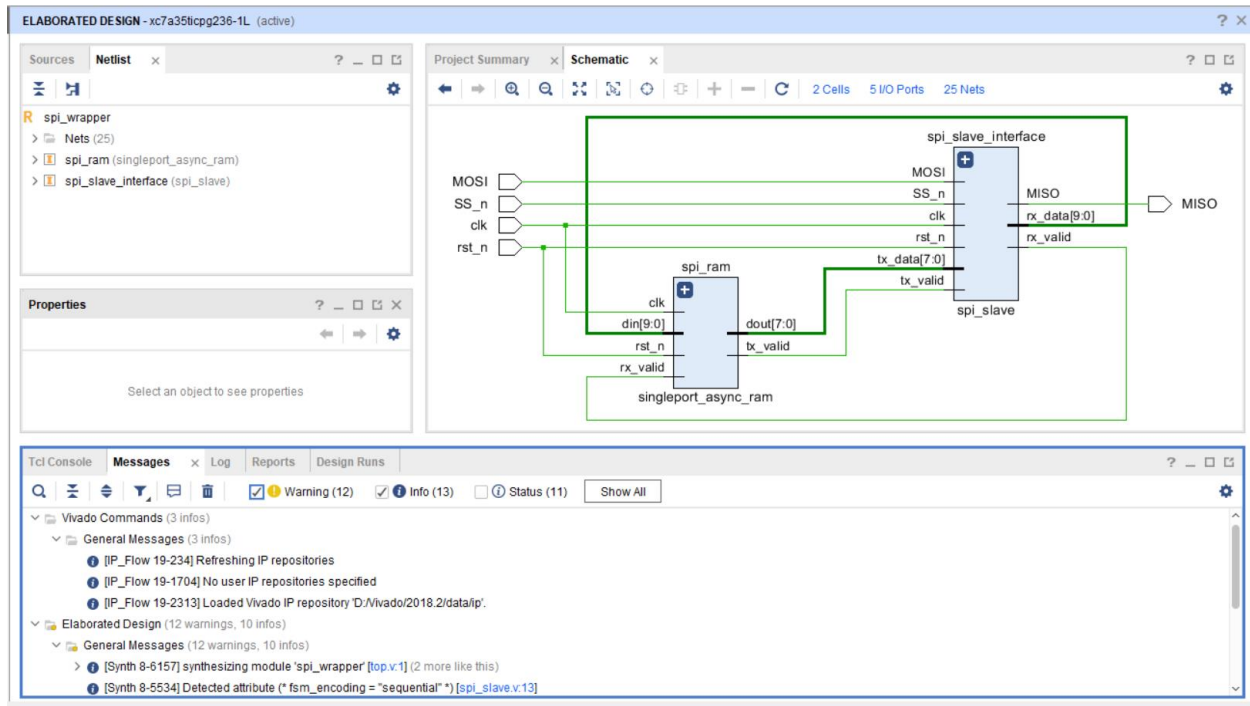
- > Slice LUTs (<1%)
 - LUT as Logic (<1%)
- > Slice Registers (<1%)
 - Register as Flip Flop

Resource	Utilization	Available	Utilization %
LUT	41	20800	0.20
FF	33	41600	0.08
BRAM	0.50	50	1.00
IO	5	106	4.72

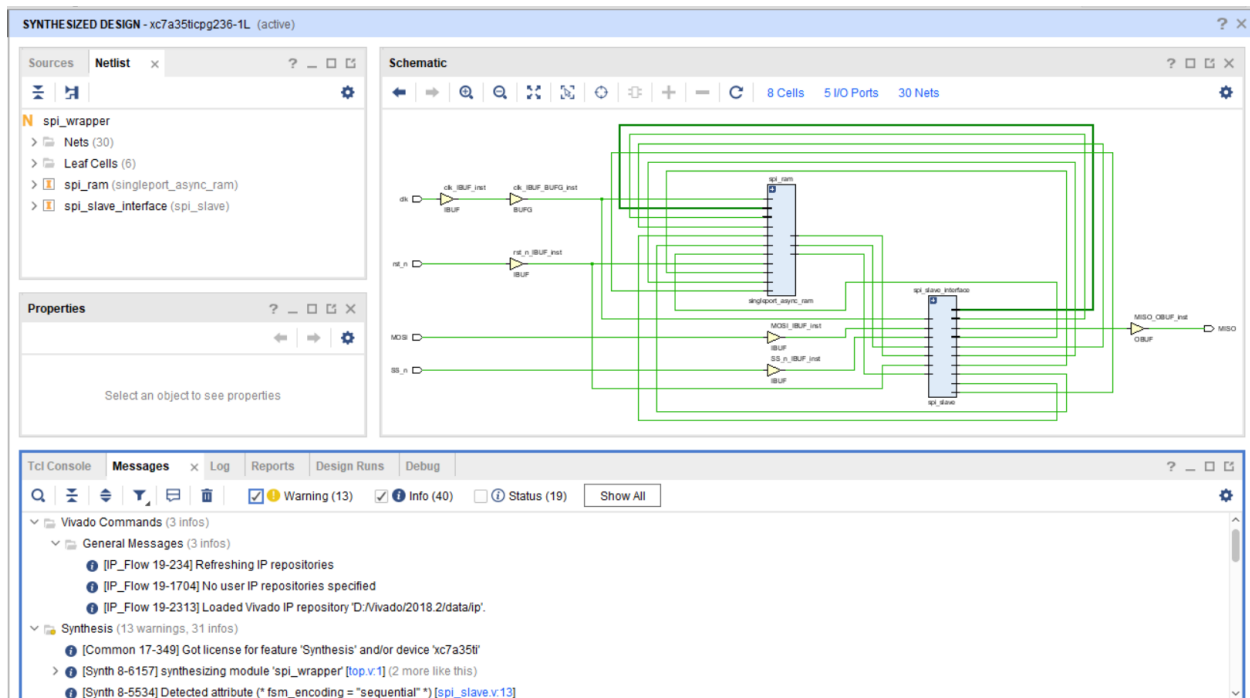
utilization_1

For sequential encoding

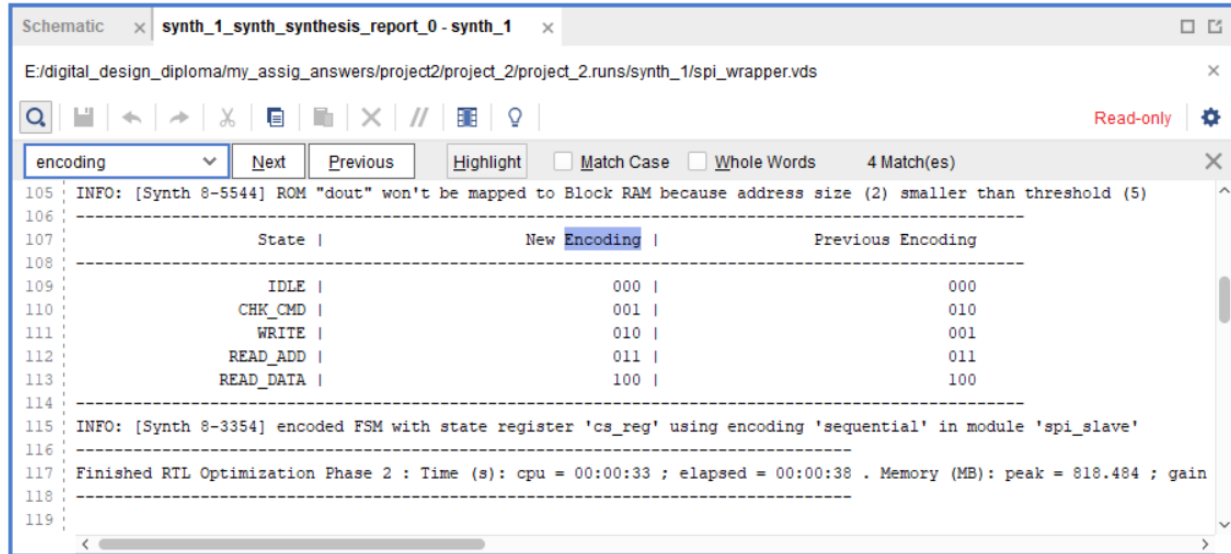
Elaboration:



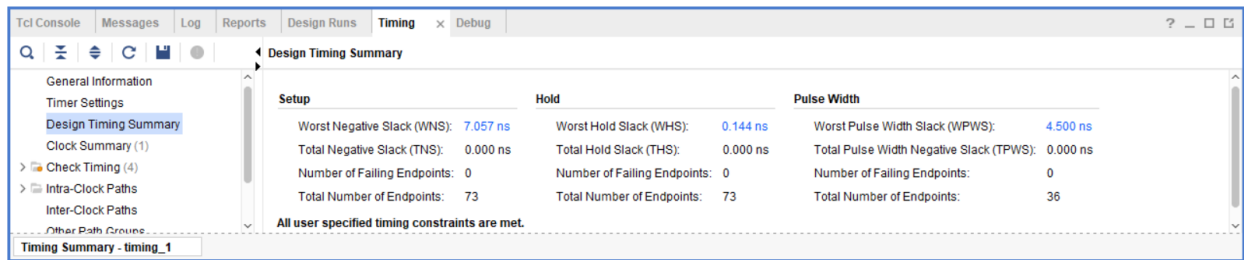
Synthesis



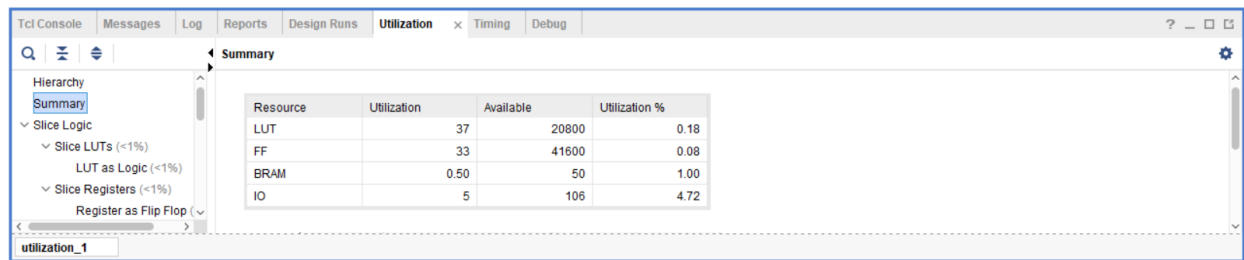
Synthesis report



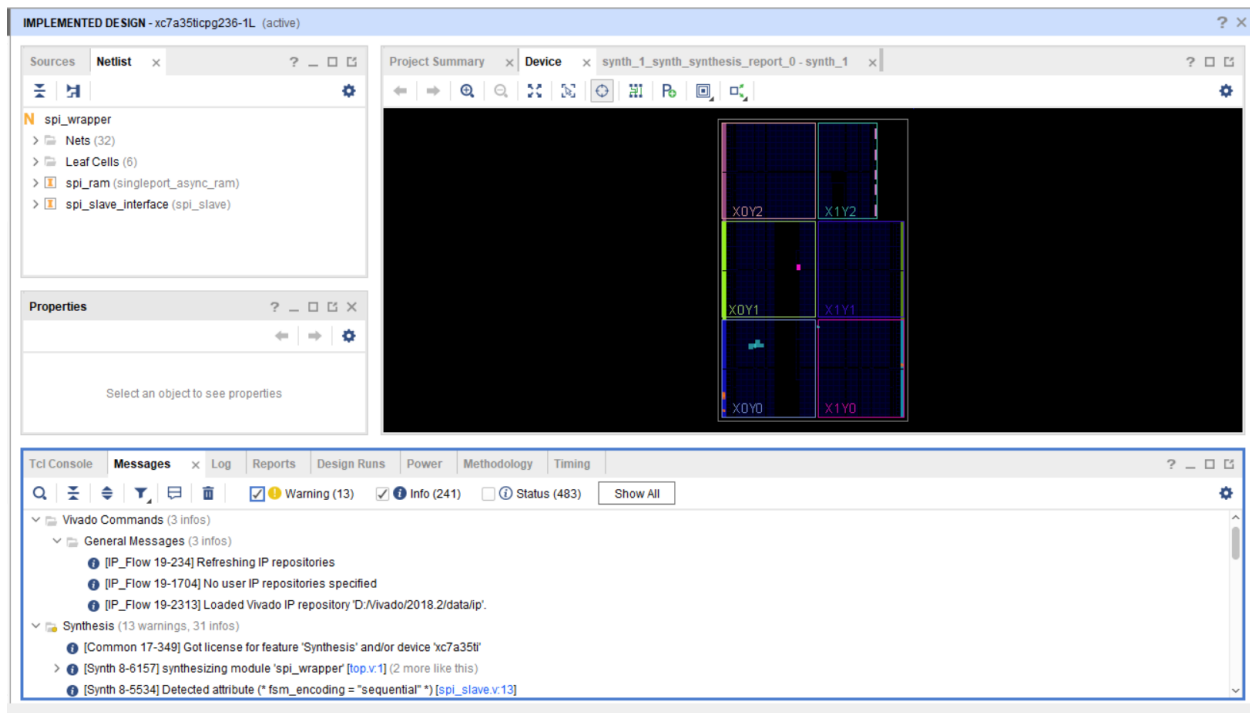
Timing report



Utilization



Implementation



Timing report

Design Timing Summary			
Setup	Hold	Pulse Width	
Worst Negative Slack (WNS): 6.928 ns	Worst Hold Slack (WHS): 0.054 ns	Worst Pulse Width Slack (WPWS): 4.500 ns	
Total Negative Slack (TNS): 0.000 ns	Total Hold Slack (THS): 0.000 ns	Total Pulse Width Negative Slack (TPWS): 0.000 ns	
Number of Failing Endpoints: 0	Number of Failing Endpoints: 0	Number of Failing Endpoints: 0	
Total Number of Endpoints: 73	Total Number of Endpoints: 73	Total Number of Endpoints: 36	
All user specified timing constraints are met.			

Timing Summary - impl_1 (saved)

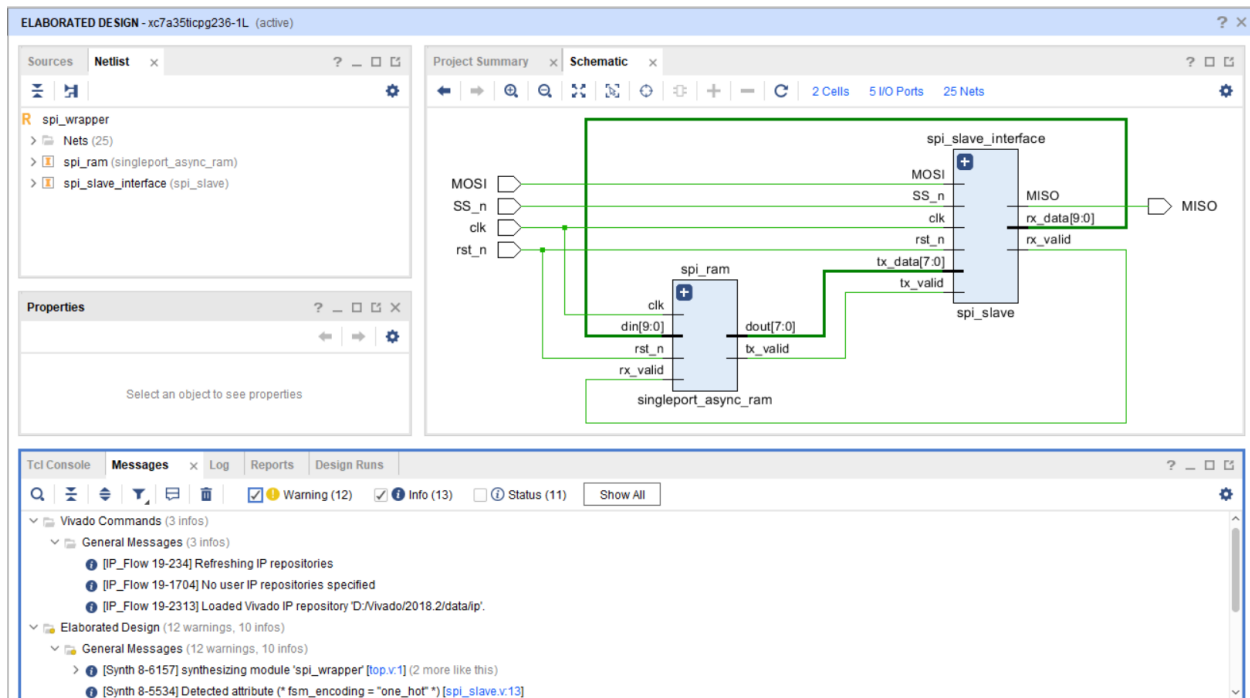
Utilization

Summary				
Resource	Utilization	Available	Utilization %	
LUT	38	20800	0.18	
FF	33	41600	0.08	
BRAM	0.50	50	1.00	
IO	5	106	4.72	

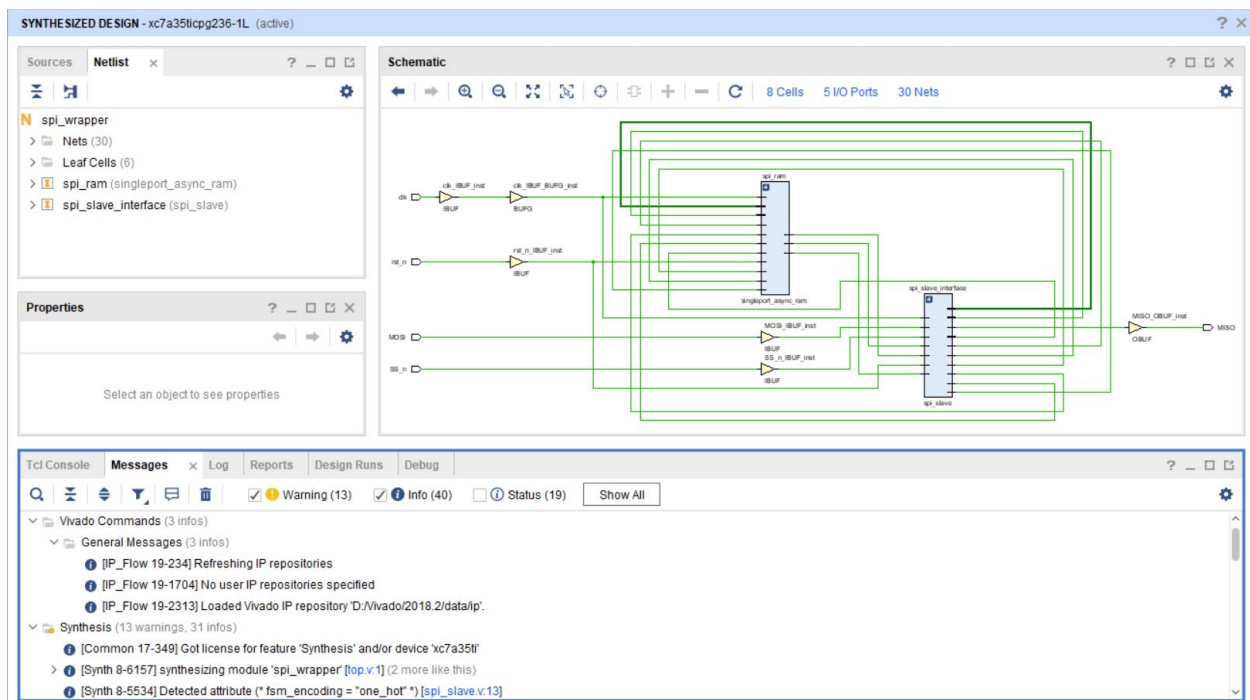
utilization_1

For one hot encoding

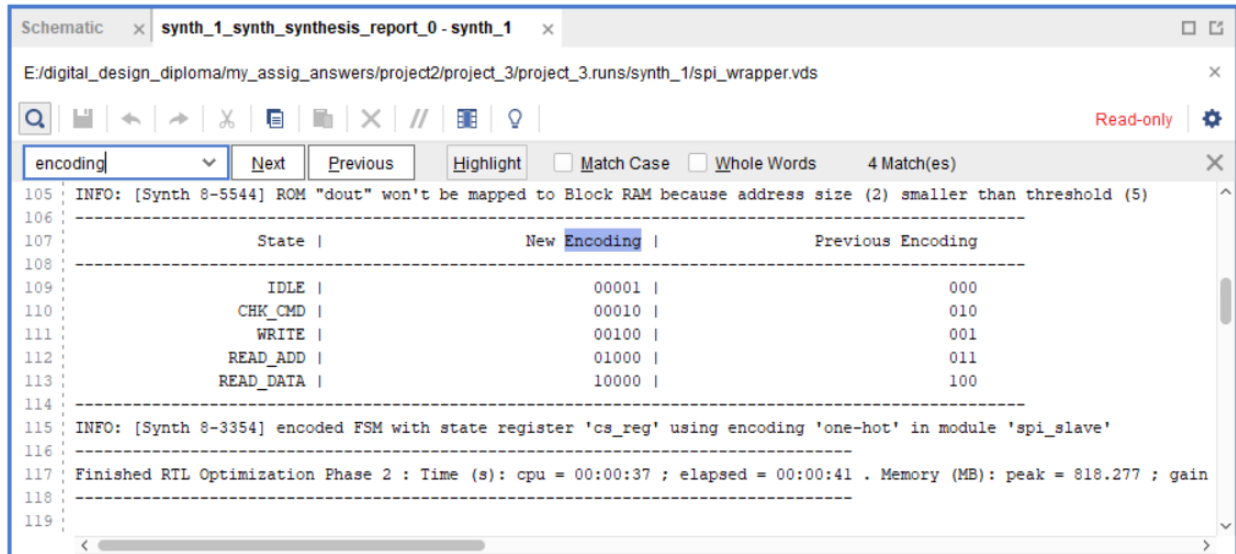
Elaboration:



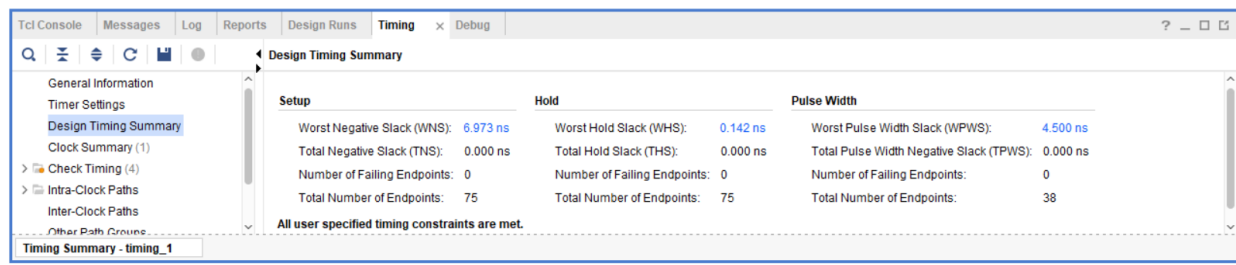
Synthesis



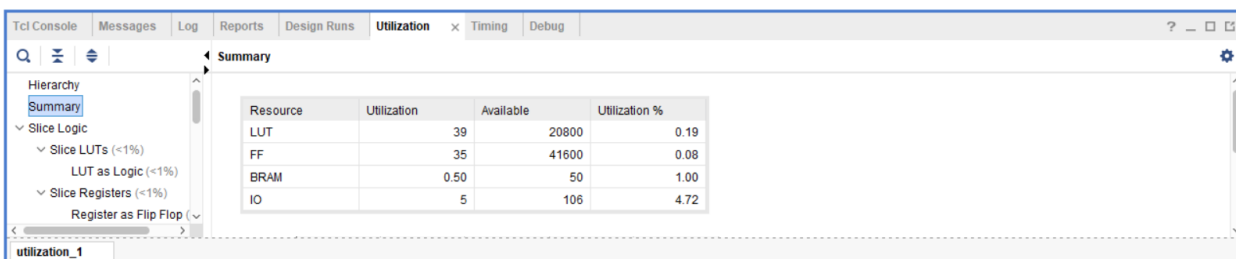
Synthesis report



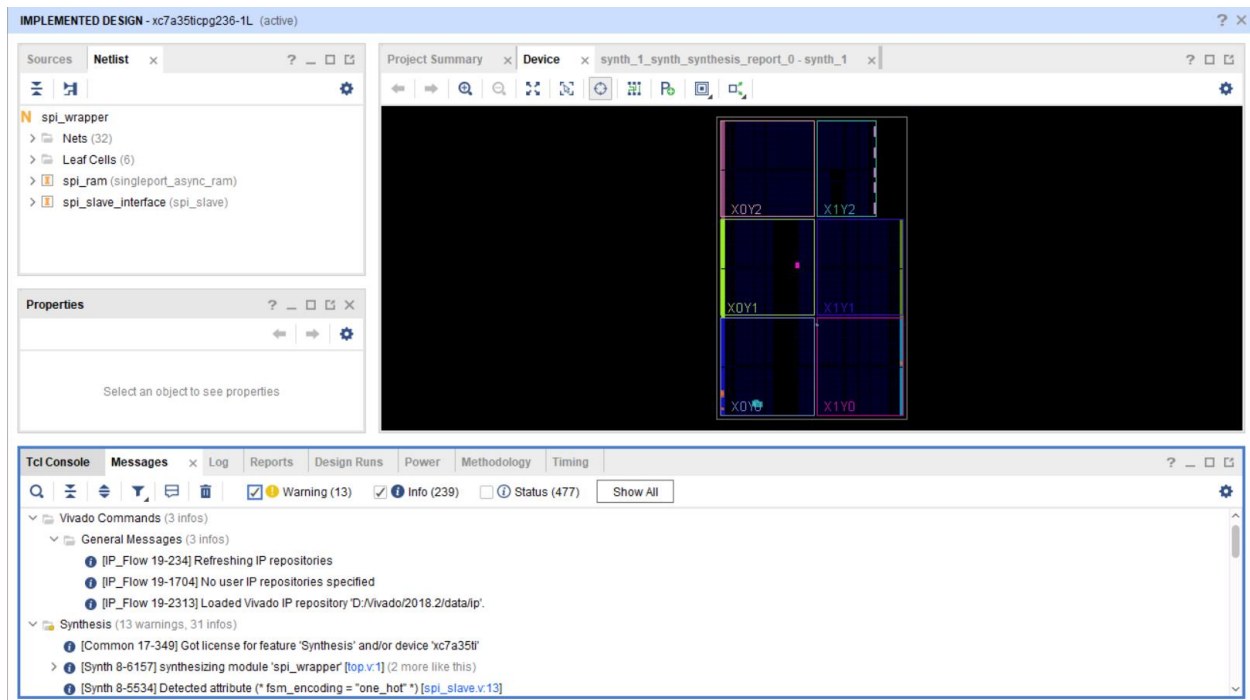
Timing report



Utilization



Implementation



Timing report

Timing Summary - impl_1 (saved)

Setup	Hold	Pulse Width
Worst Negative Slack (WNS): 6.666 ns	Worst Hold Slack (WHS): 0.083 ns	Worst Pulse Width Slack (WPWS): 4.500 ns
Total Negative Slack (TNS): 0.000 ns	Total Hold Slack (THS): 0.000 ns	Total Pulse Width Negative Slack (TPWS): 0.000 ns
Number of Failing Endpoints: 0	Number of Failing Endpoints: 0	Number of Failing Endpoints: 0
Total Number of Endpoints: 75	Total Number of Endpoints: 75	Total Number of Endpoints: 38

All user specified timing constraints are met.

Utilization

utilization_1

Resource	Utilization	Available	Utilization %
LUT	39	20800	0.19
FF	35	41600	0.08
BRAM	0.50	50	1.00
IO	5	106	4.72

To operate at the highest frequency possible, we should use one-hot encoding as it gives the best setup time slack and hold time slack.