

Report on Parasitic Extraction using StarRC

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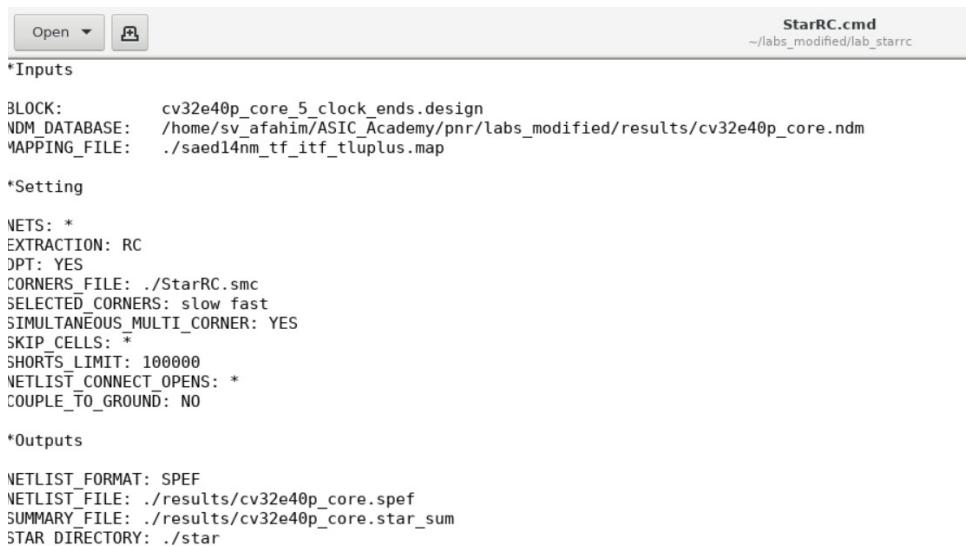
1 Introduction

This report details the process of performing Parasitic Extraction using StarRC and subsequent timing analysis using PrimeTime. The objective is to evaluate the design's timing performance, identify the worst path timing, and apply engineering change order (ECO) fixes to optimize the design. The report includes screenshots of scripts, timing reports, and ECO changes, along with global timing updates after each modification step.

2 Report Overview

The report should include the following steps:

1. After running Parasitic Extraction using StarRC, add screenshots of your script and Report Message Summary



```
StarRC.cmd
~/labs_modified/lab_starrc

*Inputs
BLOCK: cv32e40p_core_5_clock_ends.design
NDM_DATABASE: /home/sv_afahim/ASIC_Academy/pnr/labs_modified/results/cv32e40p_core.ndm
MAPPING_FILE: ./saed14nm_tf_itf_tluplus.map

*Setting
NETS: *
EXTRACTION: RC
DPT: YES
CORNERS_FILE: ./StarRC.smc
SELECTED_CORNERS: slow fast
SIMULTANEOUS_MULTI_CORNER: YES
SKIP_CELLS: *
SHORTS_LIMIT: 100000
NETLIST_CONNECT_OPENS: *
COUPLE_TO_GROUND: NO

*Outputs
NETLIST_FORMAT: SPEF
NETLIST_FILE: ./results/cv32e40p_core.spef
SUMMARY_FILE: ./results/cv32e40p_core.star_sum
STAR_DIRECTORY: ./star
```

Figure 1: StarRC.cmd



Figure 2: StarRC.smc

```

Startpoint: if_stage_i/prefetch_buffer_i/prefetch_controller_i/flush_cnt_q_reg_0_
            (rising edge-triggered flip-flop clocked by clk_i)
Endpoint: if_stage_i/prefetch_buffer_i/prefetch_controller_i/flush_cnt_q_reg_1_
            (rising edge-triggered flip-flop clocked by clk_i)
Last common pin: clk_i
Path Group: clk_i
Path Type: min

Point                         Incr      Path
-----
clock clk_i (rise edge)        0.00     0.00
clock network delay (propagated) 0.05     0.05
if_stage_i/prefetch_buffer_i/prefetch_controller_i/flush_cnt_q_reg_0_/CK (SAEDLVT14_FDPRBQ_V2LP_0P5)
                                         0.00     0.05 r
if_stage_i/prefetch_buffer_i/prefetch_controller_i/flush_cnt_q_reg_0_/Q (SAEDLVT14_FDPRBQ_V2LP_0P5)
                                         0.05 &   0.10 f
if_stage_i/prefetch_buffer_i/prefetch_controller_i/U250/X (SAEDLVT14_A0I21_0P5)
                                         0.01 &   0.11 r
if_stage_i/prefetch_buffer_i/prefetch_controller_i/U248/X (SAEDLVT14_OAI22_0P5)
                                         0.01 &   0.12 f
if_stage_i/prefetch_buffer_i/prefetch_controller_i/flush_cnt_q_reg_1_/D (SAEDLVT14_FDPRBQ_V2LP_0P5)
                                         0.00 &   0.12 f
data arrival time                  0.12

clock clk_i (rise edge)        0.00     0.00
clock network delay (propagated) 0.08     0.08
if_stage_i/prefetch_buffer_i/prefetch_controller_i/flush_cnt_q_reg_1_/CK (SAEDLVT14_FDPRBQ_V2LP_0P5)
                                         0.08 r
clock convergence pessimism    0.00     0.08
inter-clock uncertainty         0.20     0.28
library hold time               0.02     0.30
data required time              0.30

data required time              0.30
data arrival time                -0.12
-----
slack (VIOLATED)                   -0.18

```

Figure 3: worst slack

2. Screenshot of PrimeTime scripts.

```

open cv32e40p_core_pt.v
set Std_cell_lib "/home/tools/PDK/SAED14_EDK/SAED14nm_EDK_STD_LVT/liberty/nldm/base/saed14lvt_base_ss0p72vm40c.db"
set link_path ** $Std_cell_lib"

read_verilog ..//reports/cv32e40p_core_output_icc2.v
current_design cv32e40p_core
link

read_parasitics ..//lab_starrc/results/cv32e40p_core.spf.slow
report_annotated_parasitics -check
#sh cat parasitics_command.log
read_sdc ..//reports/cv32e40p_core_output_icc2.sdc

update_timing -full
#reporting
report_timing -delay_type max
report_timing -delay_type max -group clk_i -from [all_registers] -to [all_registers]
report_timing -delay_type min

#fixing
set_max_transition 0.150 [get_clocks] -data_path
set_max_transition 0.100 [get_clocks] -data_path

#setup
fix_eco_timing -type setup -reportmethods {size_cell size_cell_side_load} -cell_type {combinational sequential}
set_eco_hold_buf_list [list SAEDLVT14_BUFA_1 SAEDLVT14_BUFB_3 SAEDLVT14_BUFC_4]
fix_eco_timing -type hold -buffer_list $eco_hold_buf_list
fix_eco_drc -type max_transition -methods {size_cell}
fix_eco_power -cell_type {combinational sequential} -methods {size_cell}
# 

#save outputs
write_changes -format icctcl -output eco_changes.tcl
save_session cv32e40p_core

```

Figure 4: prime time script

3. Worst path timing report.

```

Startpoint: if_stage_i/prefetch_buffer_i/prefetch_controller_i/flush_cnt_q_reg_0_
(rising edge-triggered flip-flop clocked by clk_i)
Endpoint: if_stage_i/prefetch_buffer_i/prefetch_controller_i/flush_cnt_q_reg_1_
(rising edge-triggered flip-flop clocked by clk_i)
Last common pin: clk_i
Path Group: clk_i
Path Type: min

Point           Incr      Path
-----
clock clk_i (rise edge)          0.00      0.00
clock network delay (propagated) 0.05      0.05
if_stage_i/prefetch_buffer_i/prefetch_controller_i/flush_cnt_q_reg_0/_CK (SAEDLVT14_FDPRBQ_V2LP_0P5)
0.00 & 0.05 r
if_stage_i/prefetch_buffer_i/prefetch_controller_i/flush_cnt_q_reg_0/_Q (SAEDLVT14_FDPRBQ_V2LP_0P5)
0.05 & 0.10 f
if_stage_i/prefetch_buffer_i/prefetch_controller_i/U250/X (SAEDLVT14_A0I21_0P5)
0.01 & 0.11 r
if_stage_i/prefetch_buffer_i/prefetch_controller_i/U248/X (SAEDLVT14_OAI22_0P5)
0.01 & 0.12 f
if_stage_i/prefetch_buffer_i/prefetch_controller_i/flush_cnt_q_reg_1/_D (SAEDLVT14_FDPRBQ_V2LP_0P5)
0.00 & 0.12 f
data arrival time                0.12

clock clk_i (rise edge)          0.00      0.00
clock network delay (propagated) 0.08      0.08
if_stage_i/prefetch_buffer_i/prefetch_controller_i/flush_cnt_q_reg_1/_CK (SAEDLVT14_FDPRBQ_V2LP_0P5)
0.08 r
clock reconvergence pessimism   0.00      0.08
inter-clock uncertainty         0.20      0.28
library hold time               0.02      0.30
data required time              0.30
-----
data required time              0.30
data arrival time               -0.12
-----
slack (VIOLATED)                -0.18

```

Figure 5: worst path

4. Report global timing for the design .

The screenshot shows a software window with two tabs: "parasitics_command.log" and "sta_global40Before.tim". The "sta_global40Before.tim" tab is active, displaying a command-line report for global timing analysis.

```
*****
Report : global_timing
    -format { narrow }
Design : cv32e40p_core
Version: W-2024.09-SP5
Date   : Sun Aug 10 15:34:39 2025
*****
```

Setup violations

	Total	reg->reg	in->reg	reg->out	in->out
WNS	-0.058	0.000	-0.058	0.000	0.000
TNS	-1.939	0.000	-1.939	0.000	0.000
NUM	65	0	65	0	0

Hold violations

	Total	reg->reg	in->reg	reg->out	in->out
WNS	-0.181	-0.181	0.000	0.000	0.000
TNS	-304.739	-304.739	0.000	0.000	0.000
NUM	2237	2237	0	0	0

1

Figure 6: Global time 40 before fix

5. Screenshot of histogram for endpoint Slack for clk_i group and path inspector for the worst clk_i path for setup.

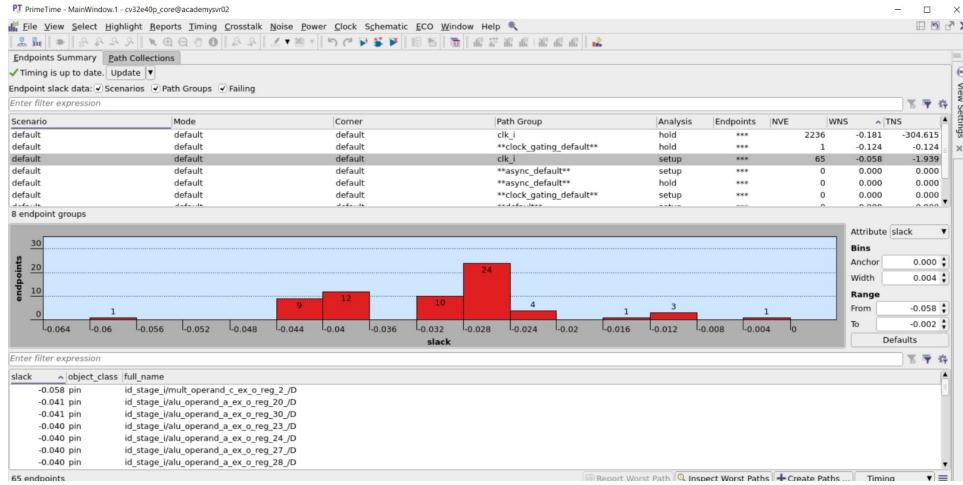


Figure 7: Histogram

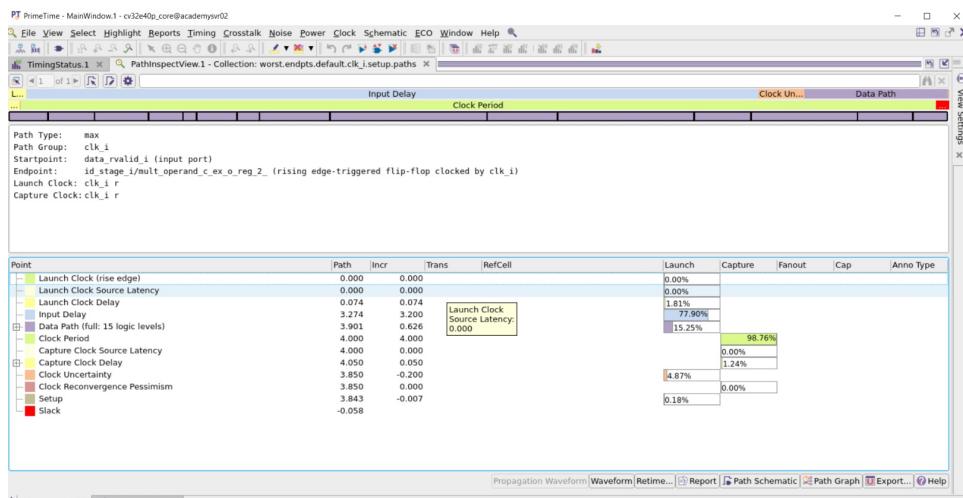


Figure 8: path view

6. report delay calculation of a selected cell from your choice, and include it in your report.

```
pt_shell> report_delay_calculation -from {load_store_unit_i/placeHFSINV_4585_25/A} -to {load_store_unit_i/placeHFSINV_4585_25/X}
```

Figure 9: report delay calculation

```

report_delay_calculation -from {load_store_unit_i/placeHFSINV_4585_25/A} -to {load_store_unit_i/placeHFSINV_4585_25/X}
*****
Report : delay_calculation
Design : cv32e40p_core
Version: W-2024.09-SP5
Date   : Sun Aug 10 15:45:43 2025
*****


From pin: load_store_unit_i/placeHFSINV_4585_25/A
To pin:  load_store_unit_i/placeHFSINV_4585_25/X
Main Library Units: lns 1pF 1kOhm

Library: 'saed14lvt_base_ss0p72vm40c'
Library Units: lns 1pF 1kOhm
Library Cell: 'SAEDLVT14_INV_S_1P5'
arc sense:           negative_unate
arc type:            cell

RC network on pin 'load_store_unit_i/placeHFSINV_4585_25/X' :
-----
Number of elements = 170 Capacitances + 203 Resistances
Total capacitance = 0.018353 pF
Total capacitance = 0.018353 (in library unit)
Total resistance  = 0.002030 Kohm

Rise          Fall
-----
Input transition time = 0.000000  0.000000 (in library unit)
Effective capacitance = 0.018353  0.018353 (in pF)
Effective capacitance = 0.018353  0.018353 (in library unit)
Drive resistance     = 0.001000  0.001000 (in Kohm)
Output transition time = 0.036436  0.038257 (in library unit)
Cell delay          = 0.027603  0.025521 (in library unit)

Information: Defining new variable 'tmp'. (CMD-041)

```

Figure 10: delay calculation report

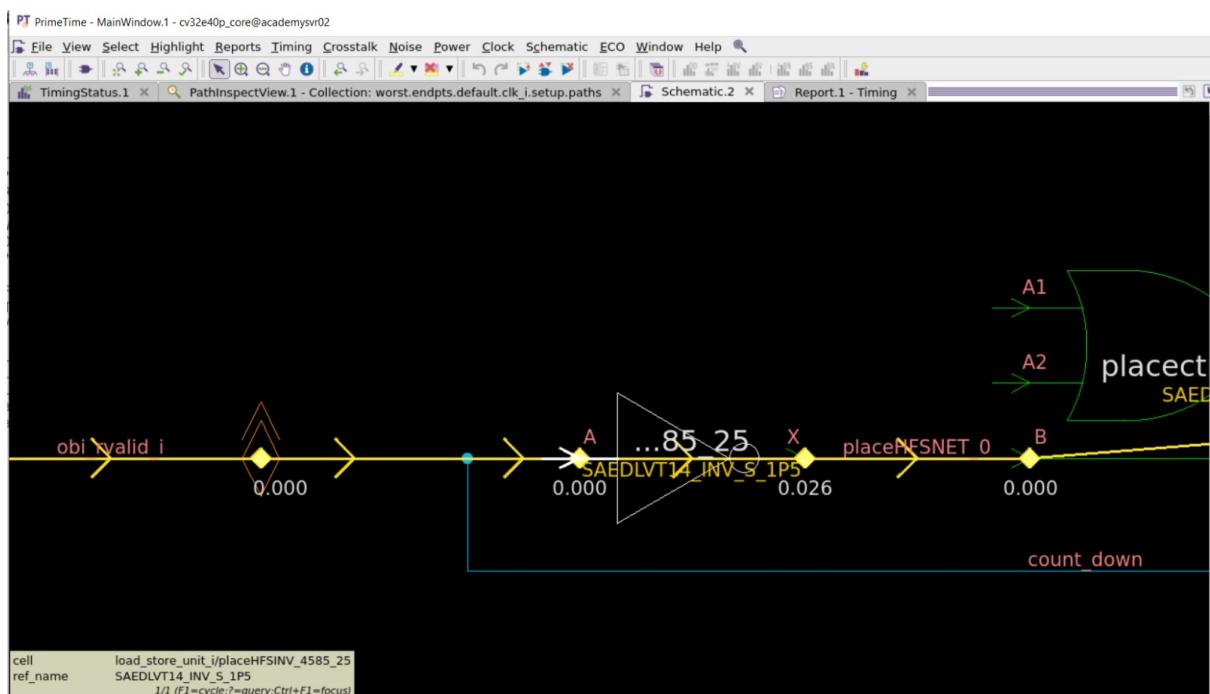


Figure 11: schematic for selected cell

7. Use the fix eco commands provided and report global timing after each step, and add it to your report.

```

sta_global40After.tir
~/labs_modified/lab_sta

parasitics_command.log x sta_global40Before.tim x sta_global40After.tim x
*****  

Report : global_timing  

  -format { narrow }  

Design : cv32e40p_core  

Version: W-2024.09-SP5  

Date   : Sun Aug 10 15:53:28 2025  

*****  

Setup violations  

-----  

      Total  reg->reg  in->reg  reg->out  in->out  

-----|  

WNS    -0.107    0.000    -0.004    -0.107    0.000  

TNS    -0.343    0.000    -0.004    -0.340    0.000  

NUM       6        0         1         5         0  

-----  

Hold violations  

-----  

      Total  reg->reg  in->reg  reg->out  in->out  

-----|  

WNS    -0.129    -0.129    0.000    0.000    0.000  

TNS    -90.227   -90.227    0.000    0.000    0.000  

NUM     1992     1992        0         0         0  

-----  

1

```

Figure 12: Global time 40 after eco fix

8. After finishing your eco fixing, write your ECO changes and add a screenshot of the file (eco changes.tcl).

```

Open  A  eco_changes.tcl
parasitics_command.log x sta_global40Before.tim x eco_changes.tcl x sta_global40After.tim x pt_shell.command.log x *pt.tcl x Synopsys_stack_trace_4526.txt x
#####
# Change list, formatted for IC Compiler
#
#
#####
current_instance
current_instance {if_stage_1}
insert_buffer [get_pins {0777/x}] SAEDLV14_DEL_L4D100_1 -new_net_names {net_PTECO_HOLD_NET1} -new_cell_names {U_PTECO_HOLD_BUF1}
size_cell {U215} {SAEDLV14_DEL_R2V3_1}
size_cell {U23} {SAEDLV14_DEL_R2V3_1}
insert_buffer [get_pins {instr_rdata_id_o_reg_19_0/}] SAEDLV14_BUF_U_0P75 -new_net_names {net_PTECO_HOLD_NET2} -new_cell_names {U_PTECO_HOLD_BUF2}
current_instance
current_instance {if_stage_1/register_file_1}
insert_buffer [get_pins {mem_reg_3_0_0/0}] SAEDLV14_DEL_L4D100_2 -new_net_names {net_PTECO_HOLD_NET3} -new_cell_names {U_PTECO_HOLD_BUF3}
insert_buffer [get_pins {mem_reg_17_0_0/0}] SAEDLV14_DEL_L4D100_2 -new_net_names {net_PTECO_HOLD_NET4} -new_cell_names {U_PTECO_HOLD_BUF4}
insert_buffer [get_pins {mem_reg_14_0_0/0}] SAEDLV14_DEL_L4D100_2 -new_net_names {net_PTECO_HOLD_NET5} -new_cell_names {U_PTECO_HOLD_BUF5}
current_instance
current_instance {if_stage_1/register_file_1}
insert_buffer [get_pins {instr_rdata_id_o_reg_20_0/}] SAEDLV14_BUF_S_0P5 -new_net_names {net_PTECO_HOLD_NET6} -new_cell_names {U_PTECO_HOLD_BUF6}
insert_buffer [get_pins {instr_rdata_id_o_reg_22_0/0}] SAEDLV14_DEL_R2V3_1 -new_net_names {net_PTECO_HOLD_NET7} -new_cell_names {U_PTECO_HOLD_BUF7}
current_instance
current_instance {if_stage_1/register_file_1}
insert_buffer [get_pins {0777/x}] SAEDLV14_DEL_R2V3_1 -new_net_names {net_PTECO_HOLD_NET8} -new_cell_names {U_PTECO_HOLD_BUF8}
insert_buffer [get_pins {0786/x}] SAEDLV14_DEL_R2V3_1 -new_net_names {net_PTECO_HOLD_NET9} -new_cell_names {U_PTECO_HOLD_BUF9}
insert_buffer [get_pins {U785/x}] SAEDLV14_DEL_R2V3_1 -new_net_names {net_PTECO_HOLD_NET10} -new_cell_names {U_PTECO_HOLD_BUF10}
insert_buffer [get_pins {U786/x}] SAEDLV14_DEL_R2V2_1 -new_net_names {net_PTECO_HOLD_NET11} -new_cell_names {U_PTECO_HOLD_BUF11}
insert_buffer [get_pins {U768/x}] SAEDLV14_DEL_R2V2_1 -new_net_names {net_PTECO_HOLD_NET12} -new_cell_names {U_PTECO_HOLD_BUF12}
insert_buffer [get_pins {0779/x}] SAEDLV14_DEL_R2V3_1 -new_net_names {net_PTECO_HOLD_NET13} -new_cell_names {U_PTECO_HOLD_BUF13}
insert_buffer [get_pins {0748/x}] SAEDLV14_DEL_R2V2_1 -new_net_names {net_PTECO_HOLD_NET14} -new_cell_names {U_PTECO_HOLD_BUF14}
insert_buffer [get_pins {U771/x}] SAEDLV14_DEL_R2V3_1 -new_net_names {net_PTECO_HOLD_NET15} -new_cell_names {U_PTECO_HOLD_BUF15}

```

Figure 13: eco changes by insert buffer

```

| insert_buffer [get_pins {insts_rdata_to_o_reg_19_4}]
size_cell {U215} {SAEDLVT14_DEL_R2V3_1}
size_cell {U23} {SAEDLVT14_DEL_R2V3_1}

```

Figure 14: eco changes by sizing

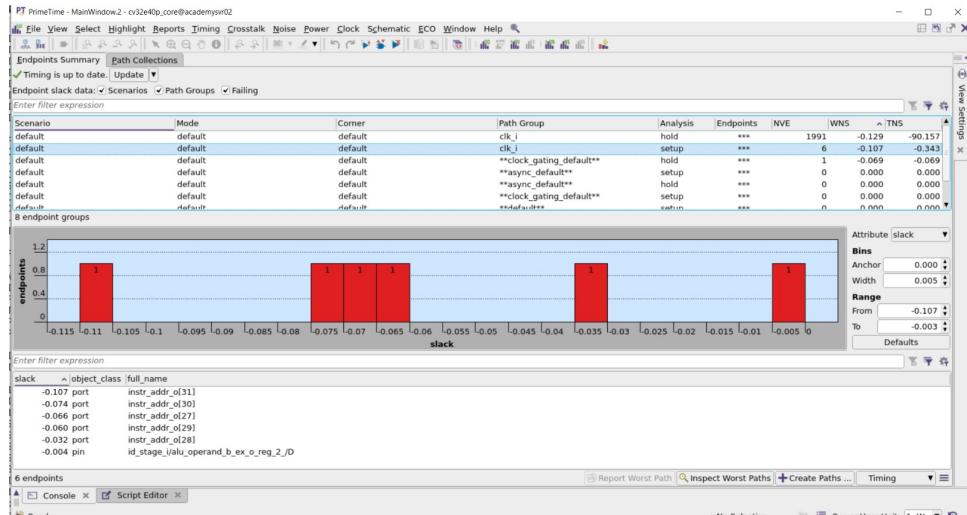


Figure 15: Histogram after fix

9. The past results are in ss0p72vm40c worst for the setup corner, relaunch your run with ff0p88v125c for the worst of hold corner, and update the timing and report the global timing for the corner used, and add it to your report with a screenshot pt script used after modifications.

The screenshot shows a text editor window with several tabs open. The active tab is named "*pt.tcl". The script content is as follows:

```

*pt.tcl
~/lab_modified/sta/sta_global40Before.tim * eco_changes.tcl * sta_global40After.tim * pt_shell_command.log * *pt.tcl * Synopsys_stack_trace_4526.txt * common.tcl *
set Std_cell_lib "/home/tools/PDK/SAED14_EDK/SAED14nm_EDK_STD_LVT/liberty/nldm/base/saed14lvt_base_ff0p88v125c.db"
set link_path ** $Std_cell_lib"
read_verilog ..//reports/cv32e40p_core_output_icc2.v
current_design cv32e40p_core
link

read_parasitics ..//lab_starrc/results/cv32e40p_core.spf.fast
report_annotationed_parasitics -check
#sh cat parasitics command.log
read_sdc ..//reports/cv32e40p_core_output_icc2.sdc

update_timing -full
#reporting
report_timing -delay_type max
report_timing -delay_type max -group clk_i -from [all_registers] -to [all_registers]
report_timing -delay_type min

#fixing
set_max_transition 0.15 [get_clocks] -data_path
set_max_transition 0.18 [get_clocks] -data_path
report_global_timing -sig 3 > sta_global40Before.tim

#setup
fix_eco_timing -type hold -report_methods {size_cell size_cell_side_load} -cell_type {combinational sequential}
set_eco_hold_buf_list [list SAEDLVT14_BUF_1 SAEDLVT14_BUF_2 SAEDLVT14_BUF_3 SAEDLVT14_BUF_4]
fix_eco_timing -type hold -buffer_list $eco_hold_buf_list
fix_eco_drc -type max_transition -methods {size_cell}
fix_eco_power -cell_type {combinational sequential} -methods {size_cell}
report_global_timing -sig 3 > sta_global40After.tim
#
#save outputs
write_changes -format icctcl -output eco_changes.tcl
save_session cv32e40p_core

```

Figure 16: pt after modification

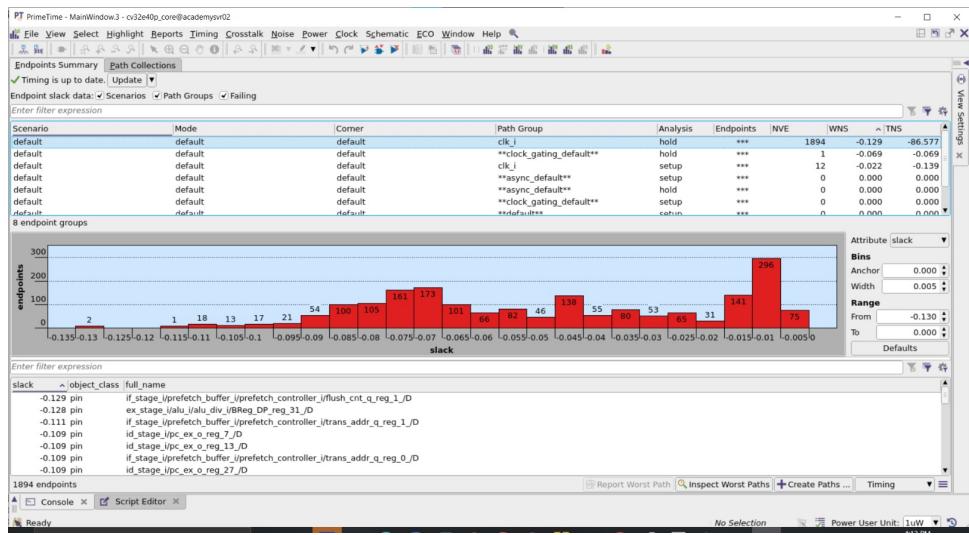


Figure 17: histogram ff

```

Open ▾ 
sta_global40Before.tim x eco_changes.tcl x sta_global40After.tim x
*****
Report : global_timing
  -format { narrow }
Design : cv32e40p_core
Version: W-2024.09-SP5
Date   : Sun Aug 10 16:16:30 2025
*****



Setup violations
-----
      Total    reg->reg    in->reg    reg->out    in->out
-----
WNS     -0.022      0.000     -0.022     -0.014      0.000
TNS     -0.139      0.000     -0.122     -0.017      0.000
NUM      12          0          10          2          0
-----


Hold violations
-----
      Total    reg->reg    in->reg    reg->out    in->out
-----
WNS     -0.129      -0.129      0.000      0.000      0.000
TNS     -86.646     -86.646      0.000      0.000      0.000
NUM     1895        1895        0          0          0
-----


1

```

Figure 18: hold global time