The PrimeClosure Paradigm: Next-Generation Tool For Enhanced TAT And ECO Fixing Rate

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Agenda

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- Realizing Highest Performance With Lowest Power
- Key ECO Challenges
- Existing ECO Flow vs PrimeClosure Flow Overview
- Single-Box ECO & Its Stages
- STA & PrimeClosure Flow Parallelism
- Leakage Power Recovery & Two Pass Loop
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- Challenges Faced & Learnings
- Conclusion
- Acknowledgement

Key Care-Abouts

PPA

Delivering Highest Levels of PPA Differentiation Across All Designs

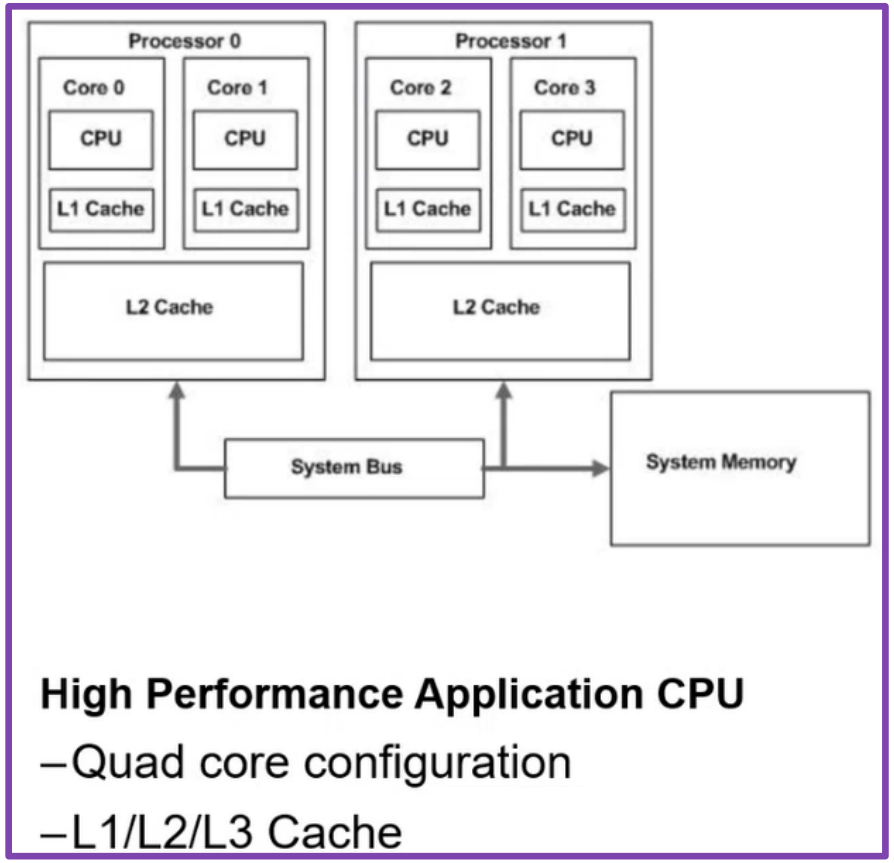
EASE OF USE

Demand a Tool-Flow that Delivers Excellent Out-of-Box (OOB) Results with Strong Ability to Push Higher

TIME TO RESULTS

Aggressive SoC Schedules Demand Fast Tool Throughput with Consistent and Repeatable Results

Realizing Highest Performance With Lowest Power



High Performance Application CPU

–Quad core configuration

–L1/L2/L3 Cache

Performance

- **Highest Frequecy**
- High logic Depth Datapath
- Setup-hold Critical mems
- Timing Critical icg paths

Power

- **Ultra low leakage and dynamic power target**
- Stringent Dhrystone and Maxpower IR target
- No / Minimal SLVT usage

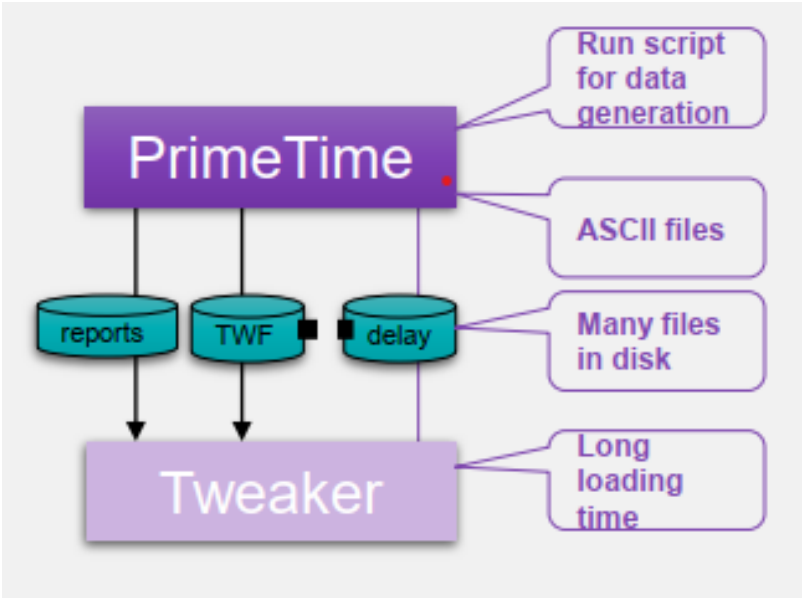
Area

- **Highest utilization**
- High density regions
- congestion hotspots and routability

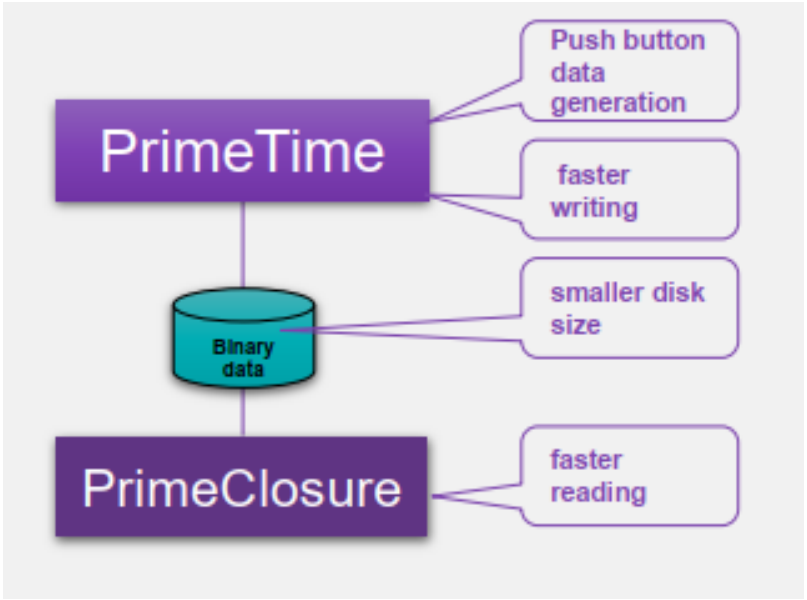
Key ECO Challenges

- Design/Process Complexity
  - Advanced process nodes bring heightened complexity to achieving design convergence.
  - Constantly changing design requirements challenges for design closure.
- Efficiency to handle dirty data (millions of violations), early-stage design
- Last 5-10% of timing violations take 90% of the ECO cycle time
- Difficulty in closure of latch dominating design
- Computational requirement & huge runtime

Existing ECO Flow vs PrimeClosure Flow Overview



Existing ECO Flow



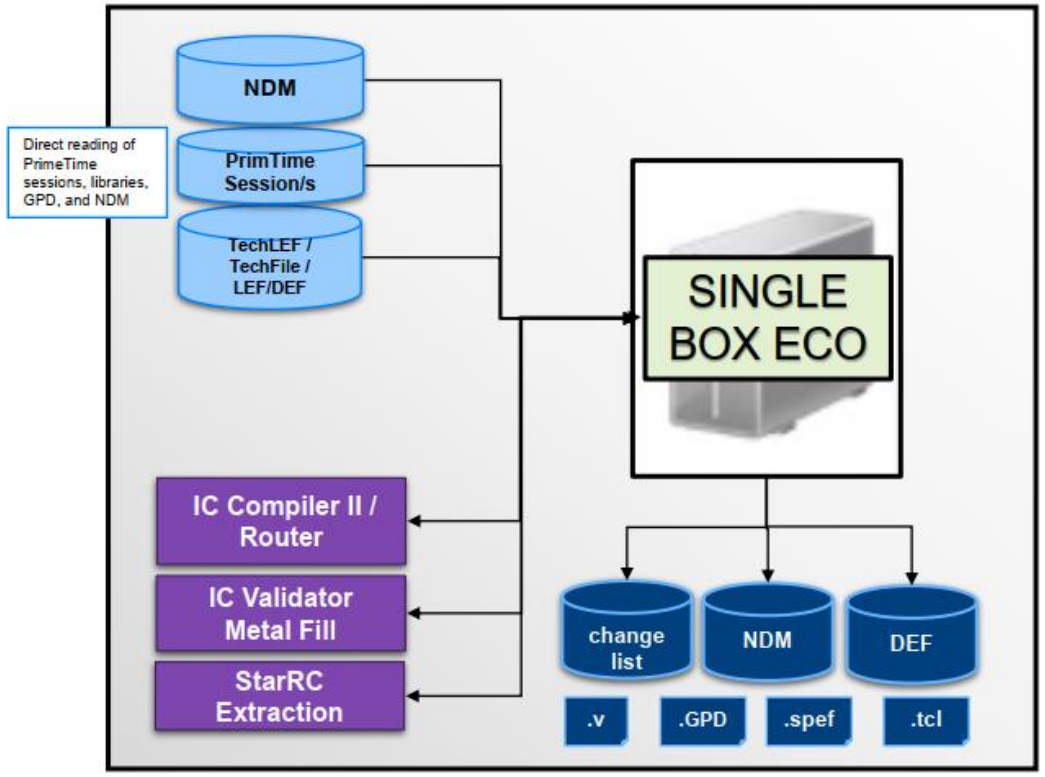
PrimeClosure ECO Flow

Binary collateral is the Game Changer !!

PrimeTime: write_eco_session –include {pt_session smsa_data} -smsa_data_type {setup hold max_transition max_capacitance} -smsa_data_format {binary } ……

PrimeClosure: read_eco_session -scenario_name scenario_name -post_restore_session_script script.tcl

Single-Box ECO




```
# Start pt_shell for ECO in scalar mode
restore_session scen1
# Assess Timing with standard PrimeTime reports within same shell
report_global_timing; report_timing; report_constraints
# Generate Data Exchange to PrimeClosure

write_eco_session <pre_eco_session_scen1>
```

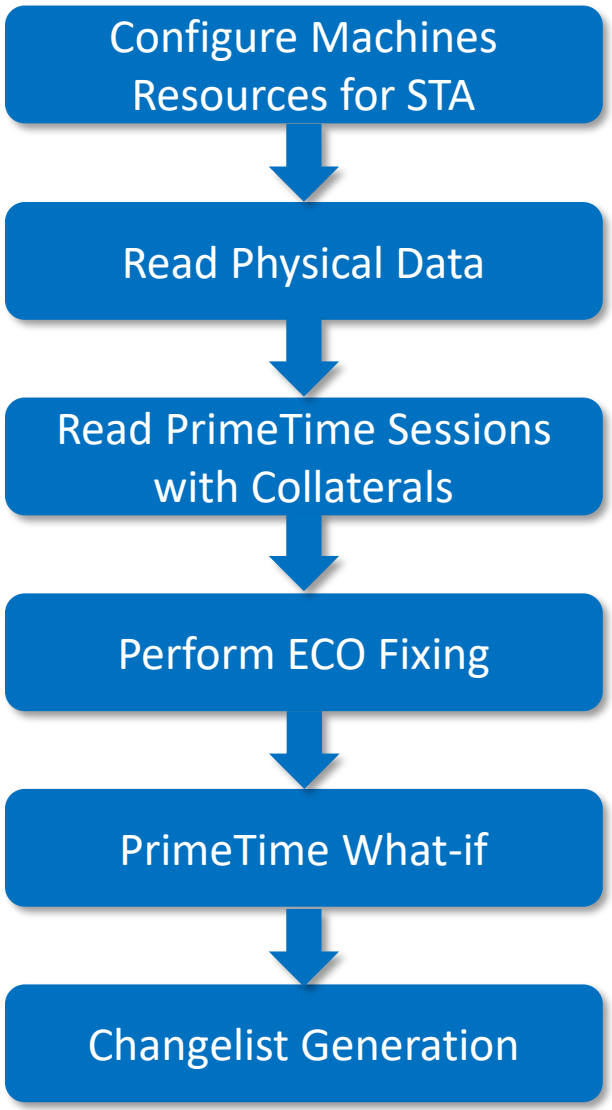
scen3 scen2 scen1

```
set multi_scenario_working_directory PC_dmsa_work_dir
set_host_options; set tech_lef [PRTF*.tlef]

read_eco_session pre_eco_session_scen1 -scenario_name scen1
read_eco_session pre_eco_session_scen2 -scenario_name scen2
read_eco_session pre_eco_session_scen3 -scenario_name scen3
read_physical_data …
start_eco
```

- ECO and STA in one cockpit
- Native legalizer for advanced nodes

PrimeClosure ECO Stages




```
set multi_scenario_working_directory PC_dmsa_work_dir
set_host_options-num_processes 3
```

```
read_physical_data -tech $tech_lef
read_physical_data -physical_icc2_lib Design.nlib
read_physical_data -physical_icc2_blocks Block_pre_eco
```

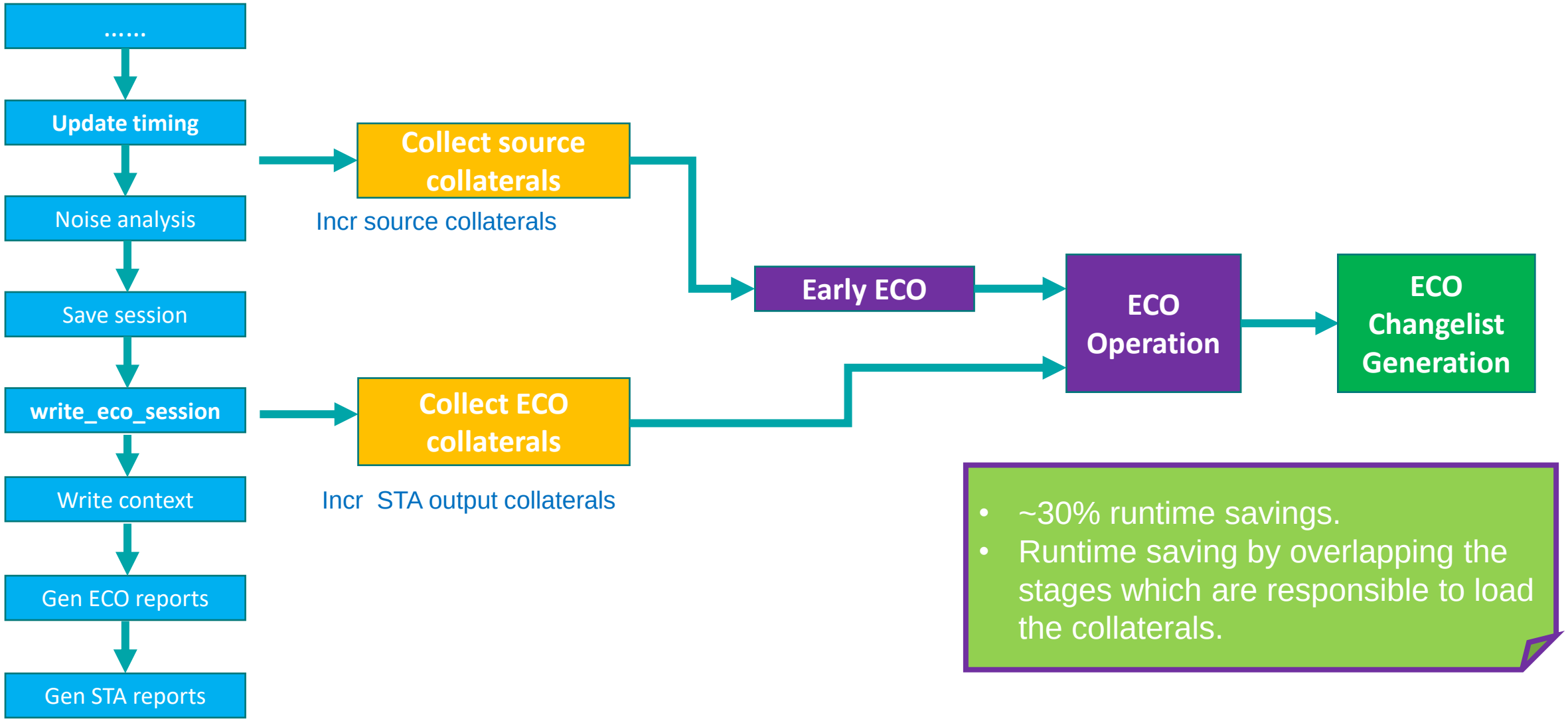
```
read_eco_session pre_eco_session
```

```
start_eco -mode smsa
#perform slack fix cmds
```

```
start_eco -mode dmsa
report_global_timing; report_constraint; report_timing
```

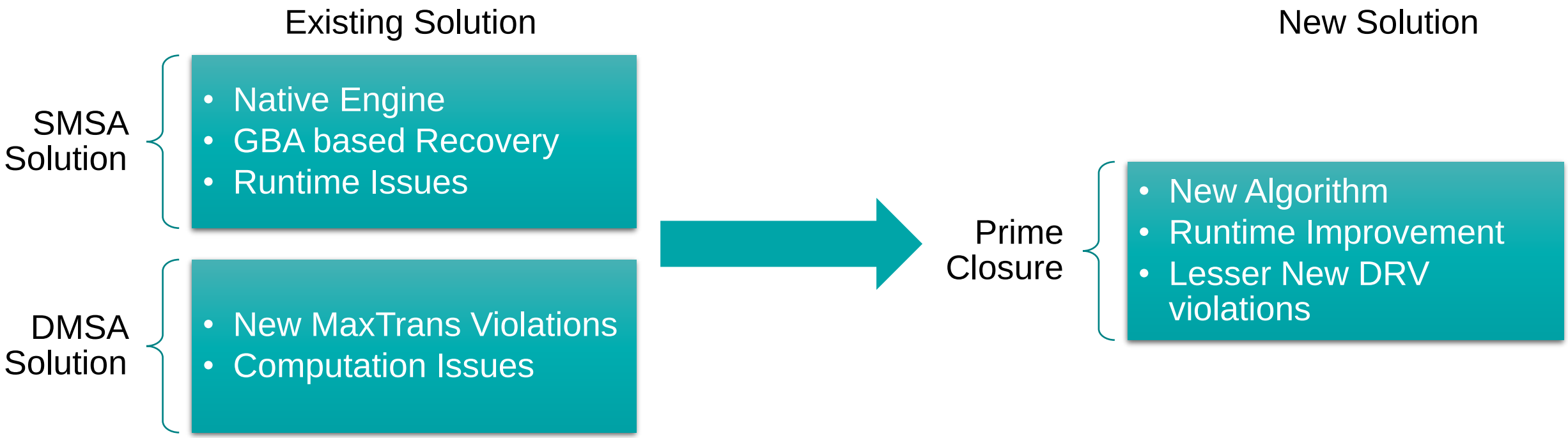
```
write_changes -format icc2tcl
```

STA & PrimeClosure ECO Parallelism



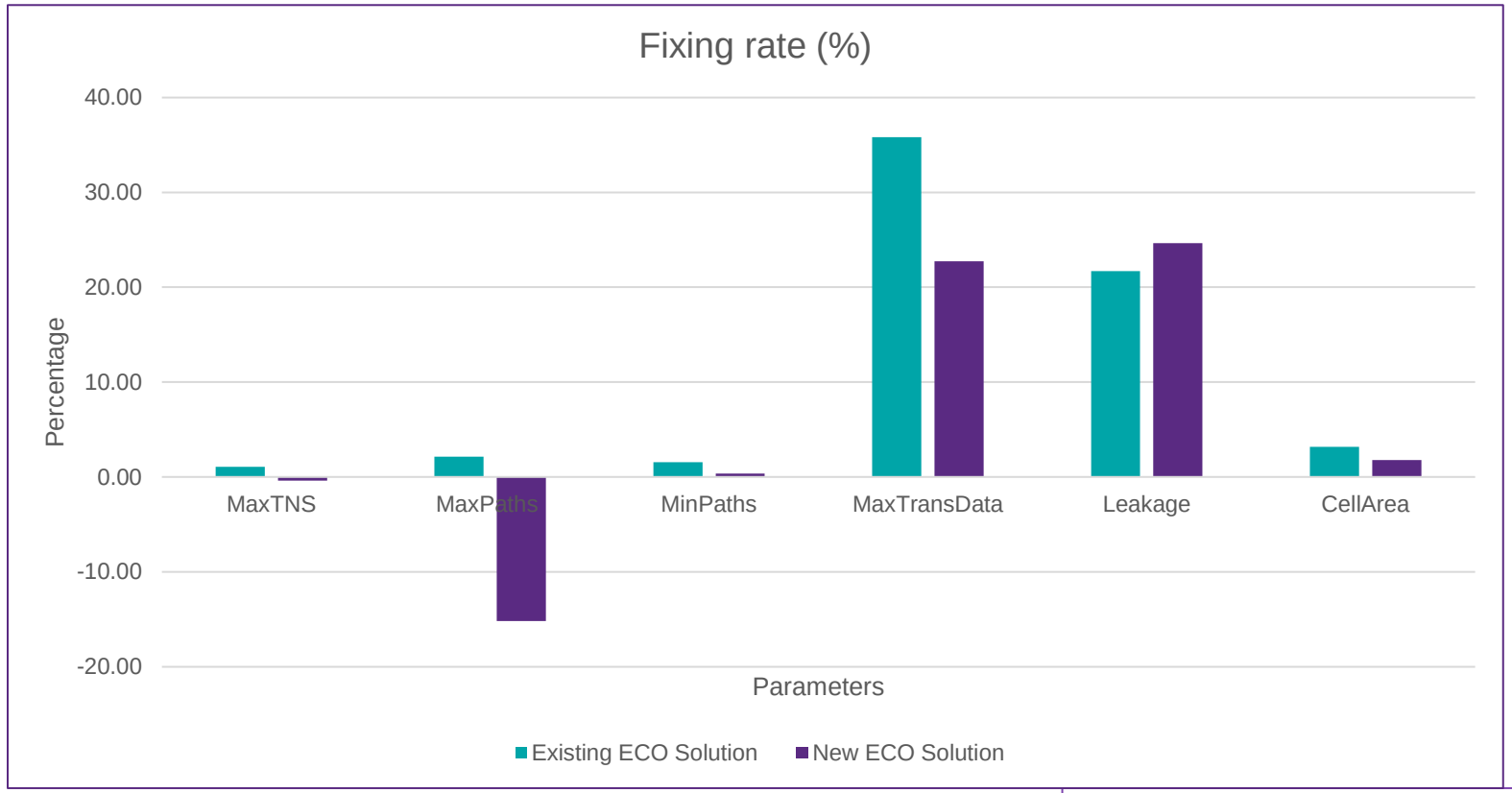
- ~30% runtime savings.
- Runtime saving by overlapping the stages which are responsible to load the collaterals.

Leakage Power Recovery

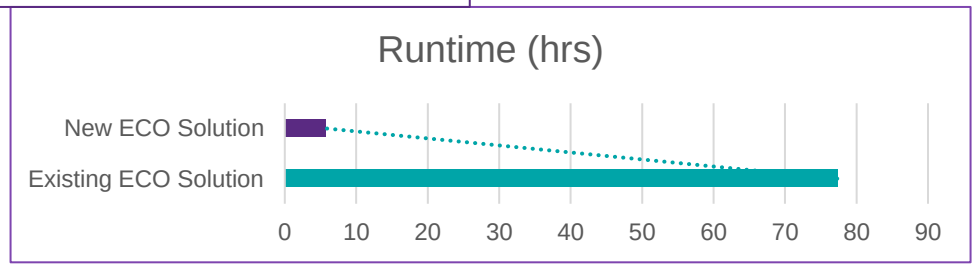


Results

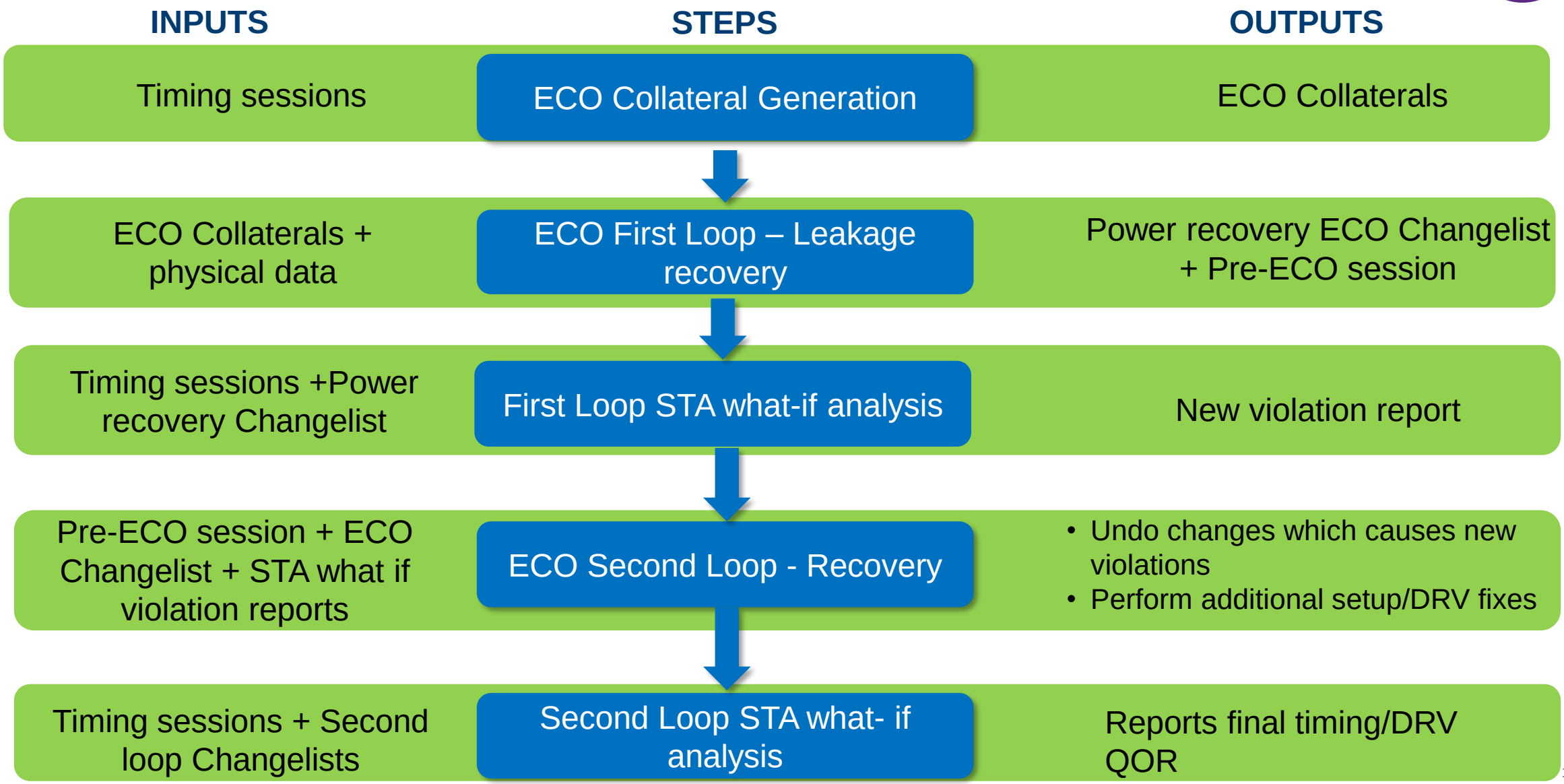
Leakage Power Recovery :Partition 1



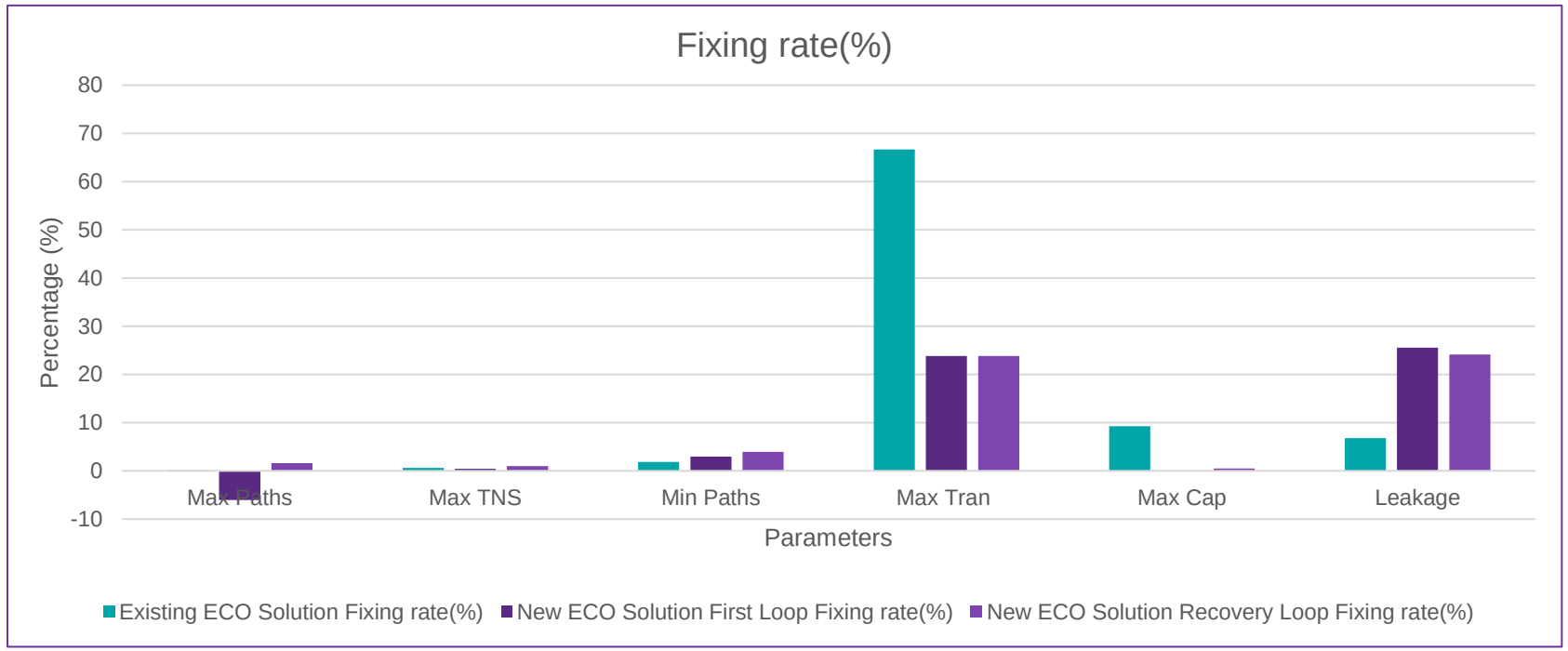
- 2.93% more leakage recovery
- 92.59% runtime reduction



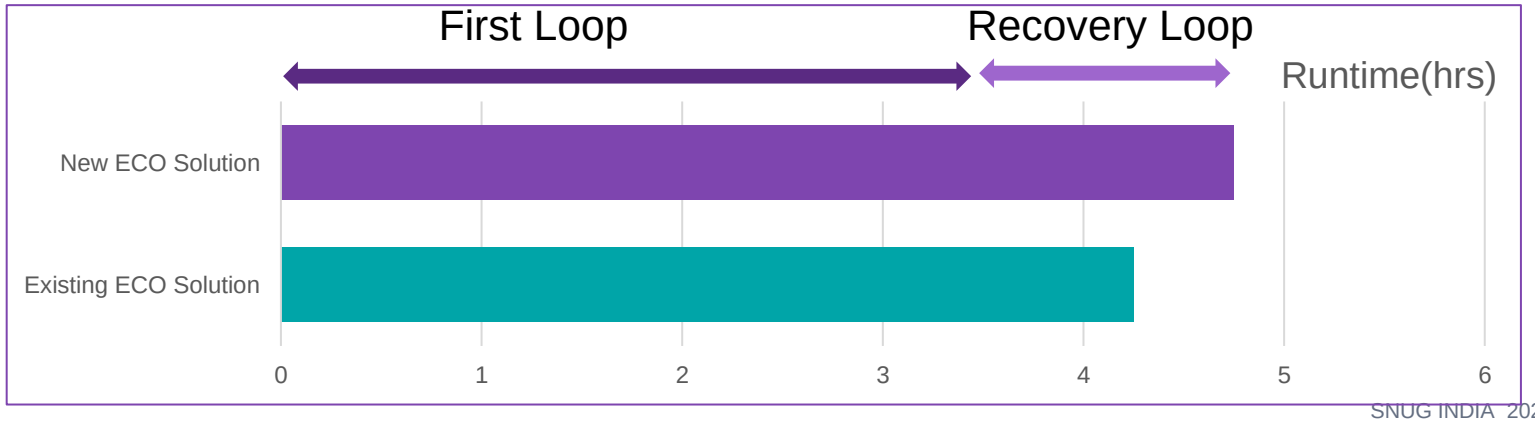
Two Pass Loop Leakage Power Recovery



Two Pass Loop Leakage Power Recovery: Partition 2

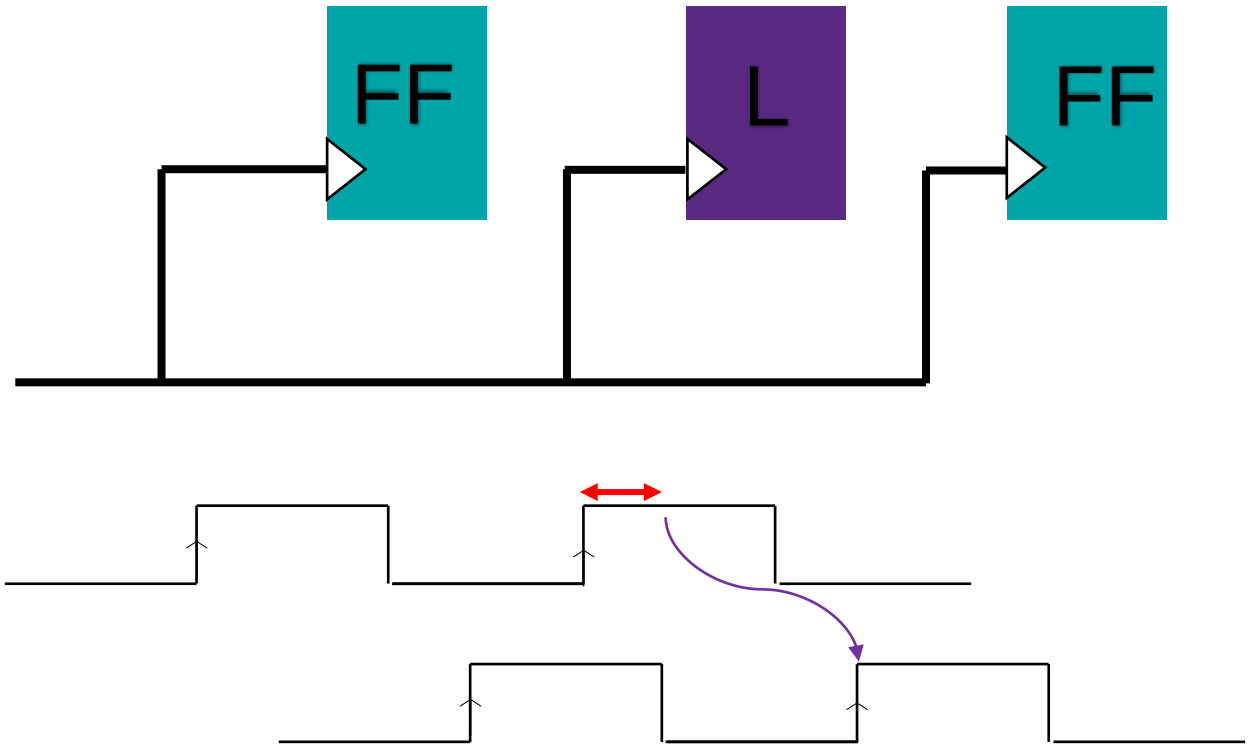


Delta in % recovery=17.37



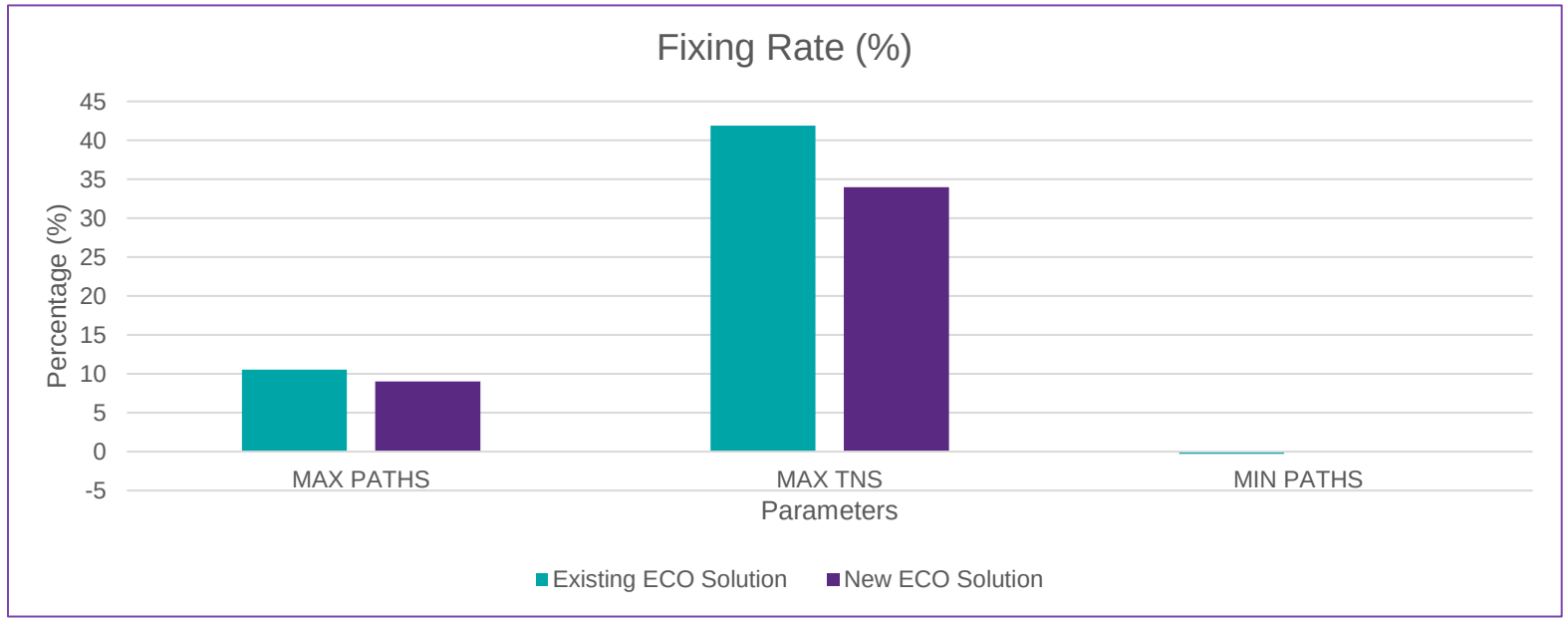
Latch Handling Challenges In ECO

- Level-Sensitivity of Latch: Time borrowing
- OCV pessimism
- Leakage recovery

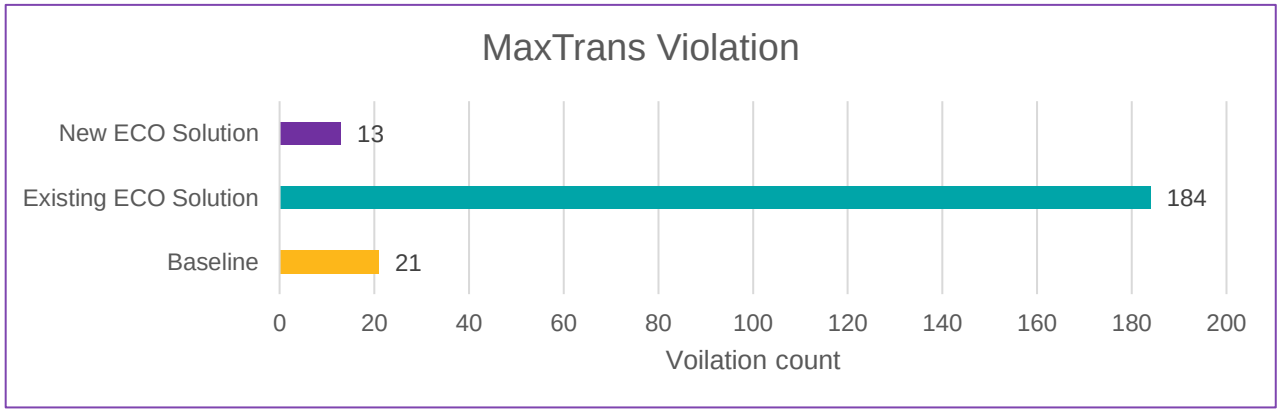


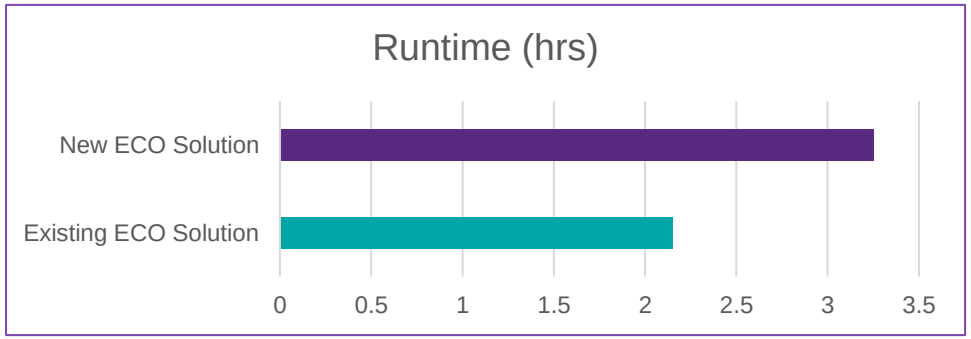
Time Borrowing in Latch

Latch Handling In ECO : Design 3



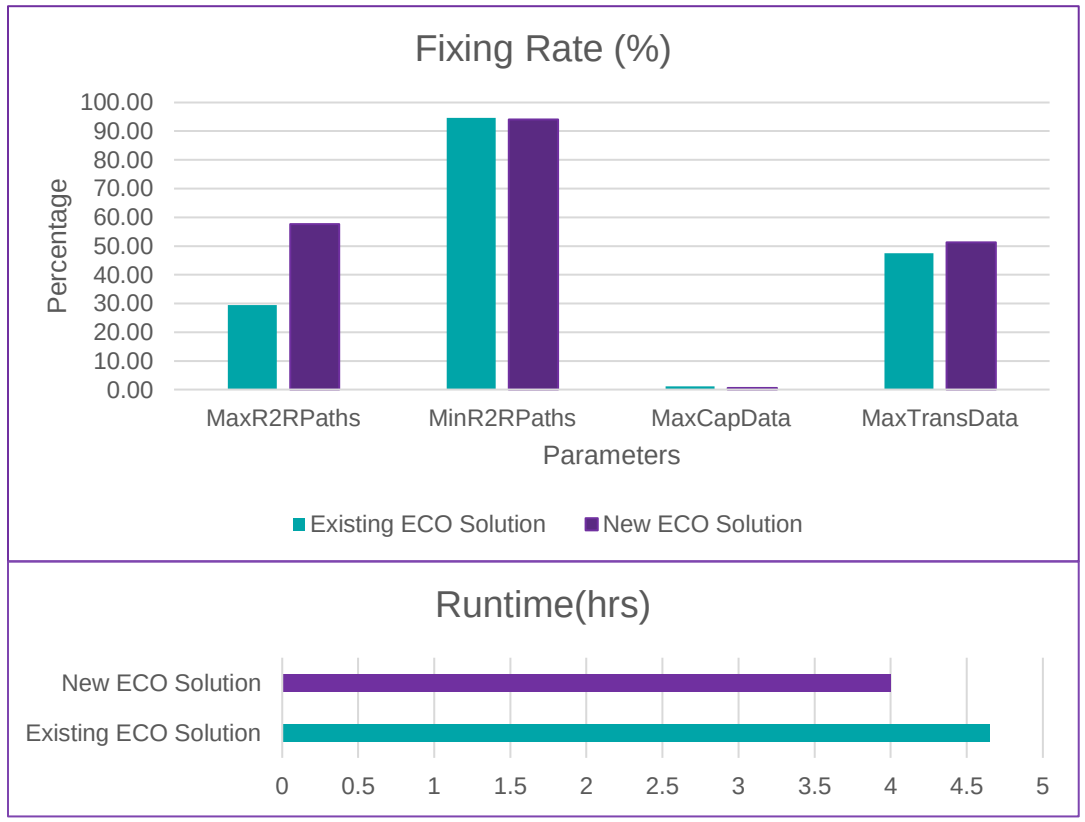
- **38.09 % MaxTrans violation reduction in latch dominating design.

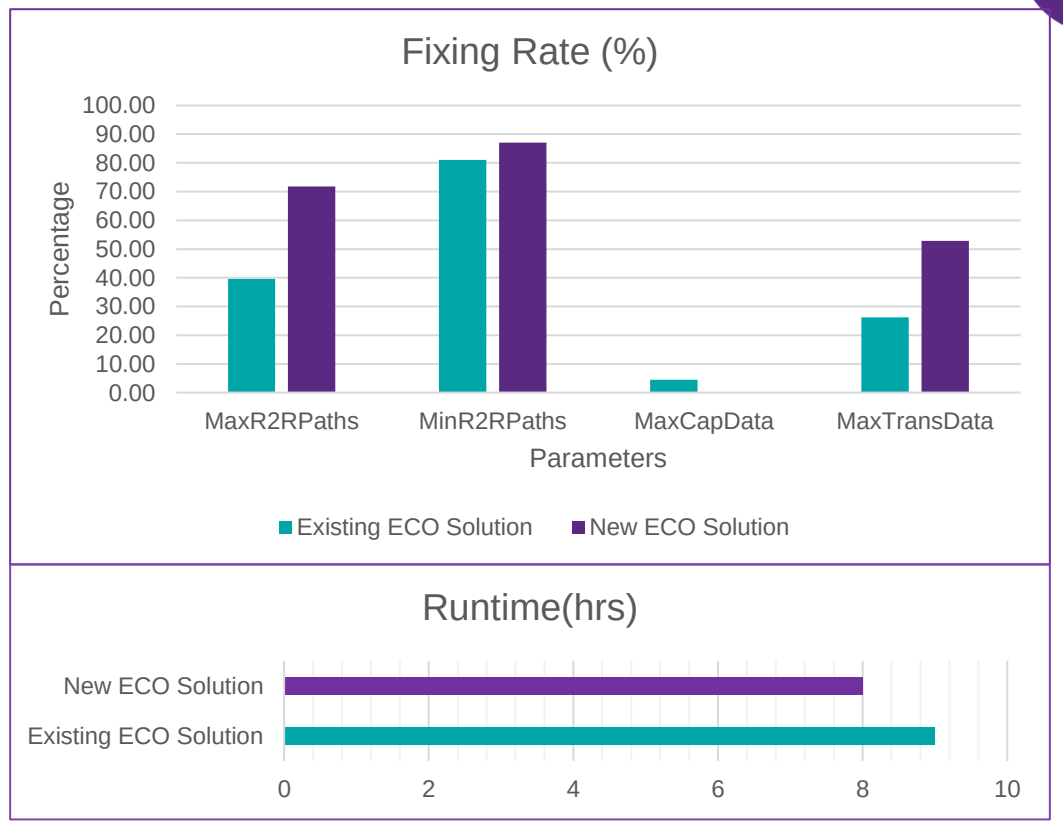




Setup, Hold & DRV

PrimeClosure Timing ECO Fixes: Partitions 4&5





Average 30% better Setup fix

Similar results in Max Cap & Hold violations

Average 15% better Max Trans fix

Average 12% runtime saving

Challenges & Learnings

Challenges Faced & Learnings

- Need for version checker: Primetime vs PrimeClosure Compatibility issues in write_eco_session
- Critical errors which are not obvious and have an impact to the run and results
- Lack of complete configurability over SMSA mode in terms of managing input collateral
- Command misalignment between ECO tool and P&R(Placement & Route) tool (most of them already addressed)

Conclusion

- New ECO Solution
  - Observed 1x-2x better timing fix rate
  - 1.5x-2x more leakage power recovery
  - Runtime benefit observed compared to the existing ECO solutions
- Multiple live projects adopted New ECO solution
  - Runtime benefit from binary collaterals
  - Better runtime for power recovery
  - Latch handling support


THANK YOU
Our Technology, Your Innovation™