TCAD Raphael

RC Extraction for BEOL

TCAD Raphael™ Base and Elite enable accurate RC extraction for complex MOL/BEOL structures used in parasitic extraction (PEX), DTCO, and interconnect materials exploration

Overview

TCAD Raphael™ Base and Elite are industry-standard field solvers for 2D and 3D interconnect analysis. They are used to calculate capacitance and resistance in complex on-chip structures.

Raphael Base continues to serve as the golden reference for parasitic extraction to tools like StarRC™.

Raphael Elite is a powerful and comprehensive Python-based tool designed for fast and efficient parasitic extraction. This new engine includes both dual processing and multi-threading allowing for more than 5x TAT and 3X memory capacity.

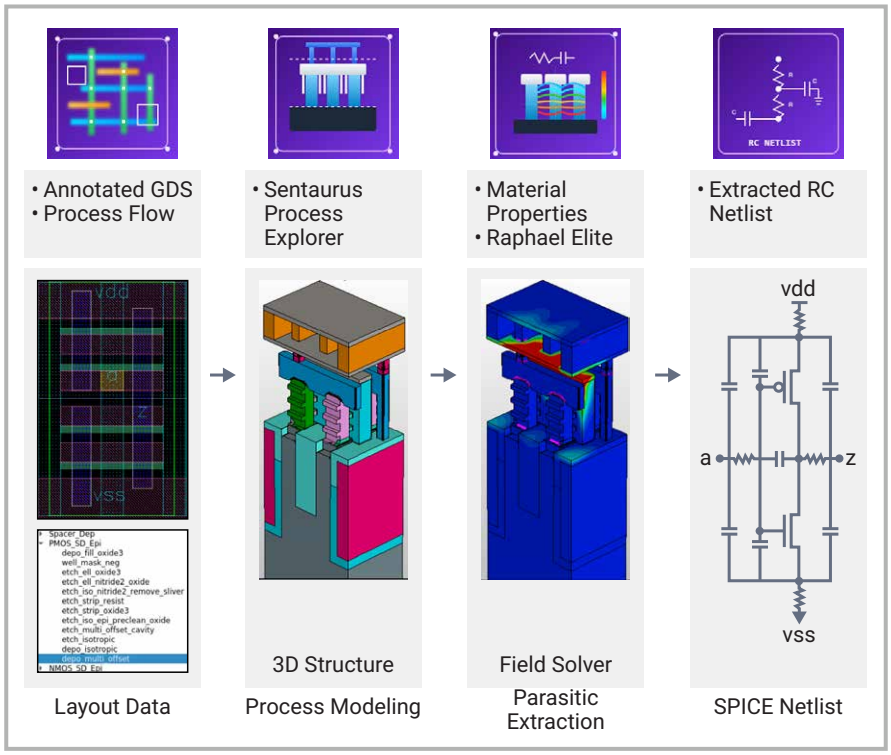

Figure 1: Raphael Elite Workflow

Highlights

- Raphael Base Gold Standard
- New Raphael Elite 5X Faster TAT and 3X increased capacity compared to Raphael FX

Target Applications

- Parasitic Extraction (PEX)
- DTCO
- Interconnect materials exploration

Technology

- MOL/BEOL

Benefits

- Raphael Base:
  - Foundry Golden Reference: Trusted as the reference tool to calibrate rule-based extractors like StarRC
- Raphael Elite:
  - Flexible Input Support: Supports structures generated from Synopsys Sentaurus™ products
  - Improved TAT and Capacity: Special schemes and new matrix solver techniques provide accurate results and faster convergence with better performance and lower memory cost

Applications

Raphael Base

Raphael Base serves as the semiconductor industry's gold-standard 2D and 3D reference field solver for parasitic extraction. Its primary value lies in delivering highly accurate calculations of resistance and capacitance (RC) for complex, non-planar on-chip interconnect structures, memory cells, and standard cells. Within Design Technology Co-Optimization (DTCO) flows, engineers apply the tool to model the impact of process variations, generate layout parameter extraction rules, and establish critical parasitic databases trusted by major foundries for design reference guides.

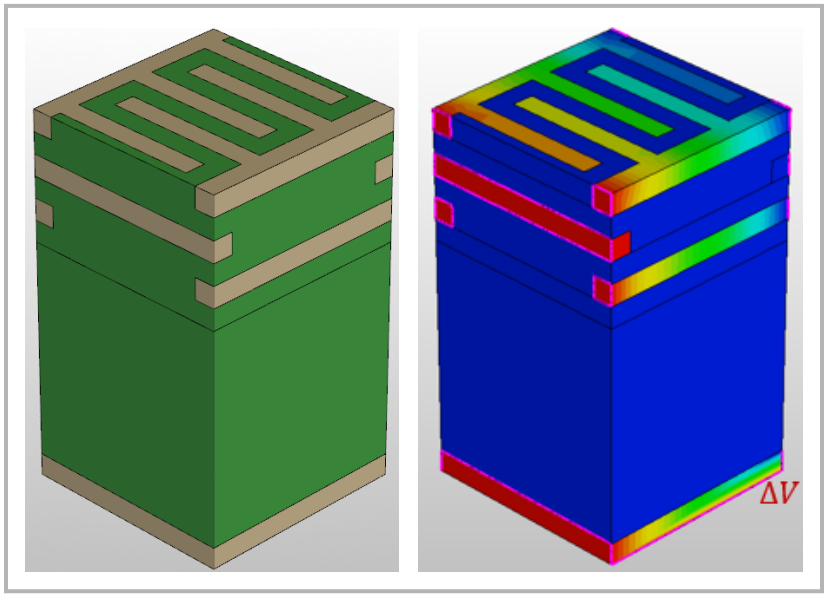

Figure 2: Best suited for regular geometries and structures

Raphael Elite

Raphael Elite (Raphael VX Engine): is a specialized, fast 3D field solver engineered to handle the massive complexity of FinFET, Gate-All-Around (GAA), and advanced memory architectures. Its primary value lies in its ability to combine foundry-level reference accuracy with accelerated computing performance, utilizing advanced voxelization and parallel processing to extract parasitic resistance and capacitance directly from physical layouts. Semiconductor teams apply the tool to perform critical DTCO, calibrate rule-based extraction tools, and model complex process variations, such as line-edge roughness and mask misalignment, at sub-3nm technology nodes such as line-edge roughness and mask misalignment, at advanced technology nodes. Advanced voxelization techniques improve extraction robustness when analyzing highly complex 3D structures.

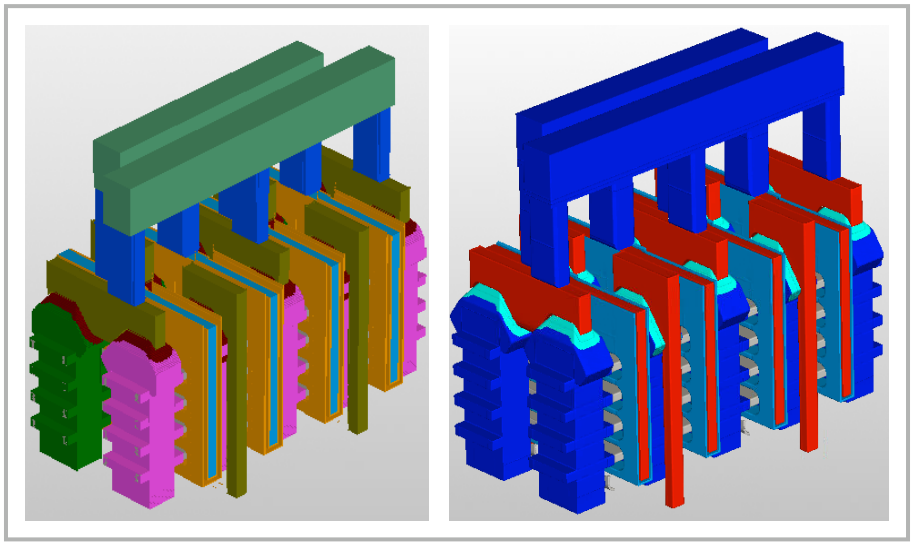

Figure 3: Applicable to both regular and irregular geometries and structures

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