



RAMTERA

TECHNICAL WHITE PAPER SERIES · PHYSICAL IMPLEMENTATION (PRE)

RAMTERA-WP20

Nonlinear Global Placement at Scale

Measured from 2,000 to 50,000 cells — with the honest comparison

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Nonlinear Global Placement at Scale: Measured Results from 2,000 to 50,000 Cells

PRE ships two global placers behind one command: a quadratic solver with density spreading, and a nonlinear analytical engine of the electrostatic family developed from Ramtera's placement research. This paper reports measured results across three design sizes and states plainly where each engine wins — including the case where the simpler engine produces the shorter wirelength.

50,000 cells placed, zero out-of-core	0.76 μm average legalization displacement (2k case)	527 rows at the largest size	1 command surface for both engines
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Measured results

Design	Rows	Flow	Outcome
2,000 cells / 1,429 nets	102	nonlinear → legalize → refine	all placed; legalization moved cells only 0.76 μm on average — the analytical output is near-legal; final HPWL 49,148 μm
2,000 cells (same design)	102	quadratic + spread → legalize	final HPWL 34,260 μm — shorter on this design (see below)
20,000 cells / 13,999 nets	334	nonlinear full flow	20,000/20,000 placed, 0 out-of-core, HPWL 1,327,194 μm
50,000 cells / 34,912 nets	527	nonlinear full flow	50,000/50,000 placed, 0 out-of-core, HPWL 4,894,613 μm

The honest comparison

The 2,000-cell design sits at roughly 6% row utilization. At that density the nonlinear engine's overflow objective is satisfied almost immediately and it stops early by design, while the quadratic engine keeps minimizing wirelength — so the quadratic result is 30% shorter. The nonlinear engine's purpose is the congested regime, where density pressure is the binding constraint; the quadratic engine remains the default for uncongested blocks. PRE reports which engine ran in every acknowledgement line, and the choice is one mode switch.

SCOPE STATEMENT — The nonlinear engine is intentionally non-deterministic run to run, as analytical placers of this family generally are. PRE's determinism guarantees (see the series' parallel-scaling papers) apply to analysis and data-preparation engines; placement quality is judged by the checker and the timer, not by checksum.

What 'near-legal' buys

An average legalization displacement under one micron means the analytical solution already respects rows and density; legalization is a snap, not a repair. That preserves the global optimization in the final layout instead of destroying it in a long legalization march.

About Ramtera

Ramtera Inc. (Delaware, USA), with R&D at Ramtera Design Automation India Pvt Ltd (Bangalore), builds electronic design automation software for physical verification and physical implementation. LVR is Ramtera's physical verification engine (DRC, LVS, ERC, XOR, parasitic extraction); PRE is Ramtera's physical implementation environment (floorplanning, placement, clock tree synthesis, routing, timing analysis and optimization), built on industry-standard command conventions so existing flow scripts and operator skills transfer directly. The company holds granted patents and registered copyrights covering its engines.

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This document reports measurements from Ramtera's engineering environment (Ubuntu 24.04, GCC 13.3, Tcl 8.6) unless stated otherwise. Product behavior and figures are subject to change; no compatibility, certification, or endorsement by any third party is stated or implied.