SOLUTION BRIEF

3D Interconnect Designer: Physically Accurate Design and Exploration of Advanced 2.5D and 3D Interconnects

KEYSIGHT

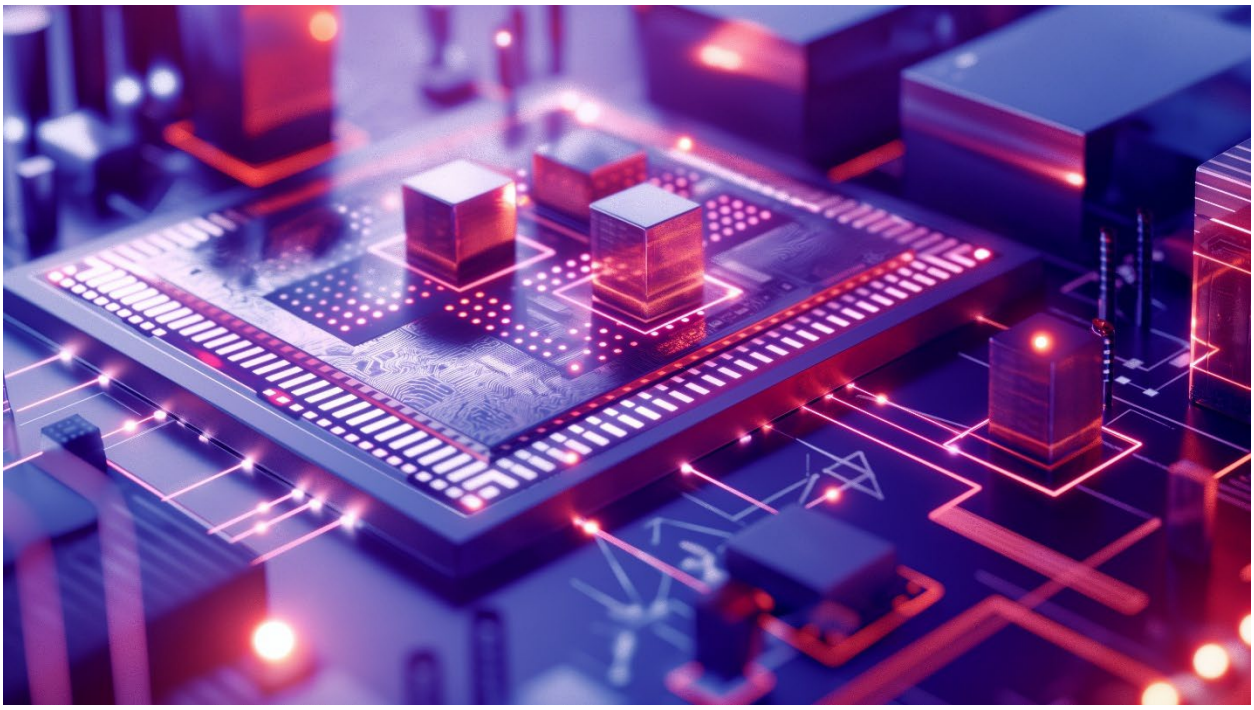
A New Approach to Interconnect Design

As advanced heterogeneous integration becomes mainstream, system architects, packaging engineers, and signal integrity specialists must make critical decisions about complex 2.5D and 3D interconnect structures early in the design process. Choices around interface architecture, grounding strategies, bump maps, and routing feasibility directly impact bandwidth, signal integrity, power delivery, and ultimately time-to-market.

However, many teams must make these decisions without physically realistic insight into how these interconnects will behave. As a result, issues such as impedance mismatches, coupling effects, return-path discontinuities, or routing congestion are often discovered late in the design cycle, when changes are costly and schedules are at risk.

3D Interconnect Designer provides a physically aware design environment that allows engineering teams to explore, validate, and optimize complex 3D interconnect architectures before committing to detailed implementation.

By enabling early insight into electrical behavior and routing feasibility, the solution helps organizations reduce redesign risk, accelerate architecture exploration, and move into layout with greater confidence.



Where Complex Interconnect Programs Stall

Heterogeneous integration programs frequently encounter delays during early architecture exploration when interconnect feasibility is uncertain. Engineering teams must evaluate multiple interface options, grounding strategies, and routing approaches while coordinating across architecture, packaging, and signal integrity groups.

Late-stage surprises: Critical interconnect or grounding issues are often discovered only after layout or fabrication.

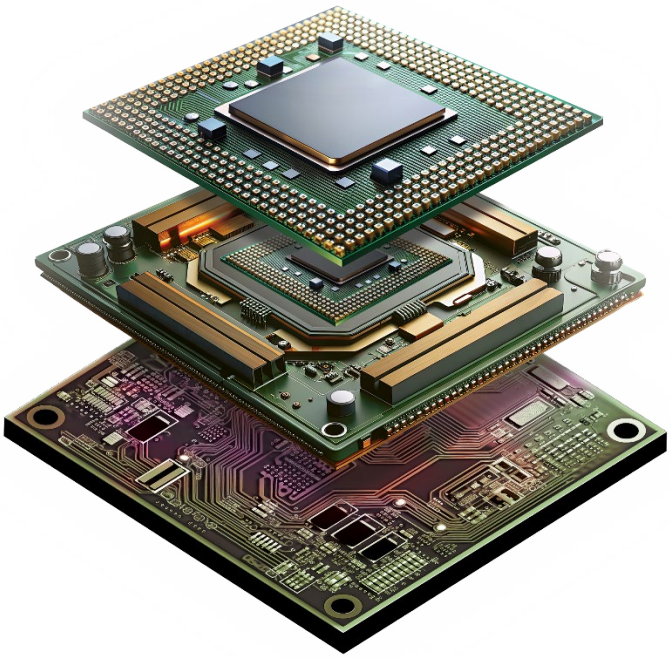
Limited pre-layout insight: Traditional approaches rely on simplified assumptions that do not capture real electrical behavior.

Iteration overhead across teams: Architecture, SI, and packaging teams must repeatedly iterate as new issues emerge.

Interface uncertainty: Design teams must evaluate open standards such as UCIe alongside proprietary interconnect strategies.

Manual, error-prone tasks: Breakout routing, multilayer alignment, and bump map exploration often require time-consuming manual effort.

Without a physically grounded exploration environment, teams struggle to confidently validate design choices before committing to implementation.



3D Interconnect Designer: From Concepts to Verified Insights

3D Interconnect Designer introduces physically realistic visibility into complex 2.5D and 3D interconnect behavior at the earliest stages of design.

Evaluate Interconnect Feasibility Before Layout

Explore interconnect architectures on silicon or organic interposers before committing to layout.

Capabilities include:

- Modeling microbumps, vias, interconnect buses, and breakout structures
- Evaluating signal integrity, impedance, and coupling behavior
- Assessing electrical performance early in the design process

This early insight helps teams validate assumptions while architectural changes are still practical.

Prevent Ground and Return Path Issues Early

Reliable high-speed chiplet interfaces depend on well-designed return paths and grounding structures.

3D Interconnect Designer enables engineers to:

- Model advanced ground structures including rectangular and diamond-hatched planes
- Visualize spatial relationships between signal and ground structures
- Identify potential return-path discontinuities

This visibility helps engineers mitigate signal integrity risks before layout implementation begins.

Compare Multiple Interface Strategies

Design teams must evaluate open standards such as UCIe alongside proprietary interconnect strategies and custom high-density routing structures.

The solution supports rapid exploration of:

- UCIe-aligned bump templates
- BoW-based interconnects
- Fully user-defined bump maps

Engineers can analyze multiple interface strategies in a flexible pre-layout environment and make informed architecture decisions.

Validate Routing Feasibility Across Chiplets

Routing across chiplets, interposers and stacked dies introduce complex physical constraints.

3D Interconnect Designer enables realistic routing exploration by:

- Simulating 2.5D routing scenarios across multiple chiplets
- Applying realistic routing constraints
- Automating repetitive tasks such as breakout routing and multilayer alignment

This capability helps teams evaluate routing capacity and avoid congestion issues before entering layout.

Integrated Simulation and Early Validation

Integrated simulation capabilities allow engineers to validate interconnect behavior at both component and system levels.

Engineers can detect:

- Bandwidth limitations
- Impedance mismatches
- Coupling effects between signal paths

Automated HTML reports simplify cross-team communication and documentation of design assumptions.

Accelerate Design Exploration with Automation

Design-space exploration can be accelerated through automation and open integration.

3D Interconnect Designer supports:

- Python-based automation for parameter sweeps and batch simulations
- Design-space exploration and optimization studies
- Integration with external analytics and machine-learning frameworks through an open API

These capabilities allow teams to evaluate more architectural options in less time.

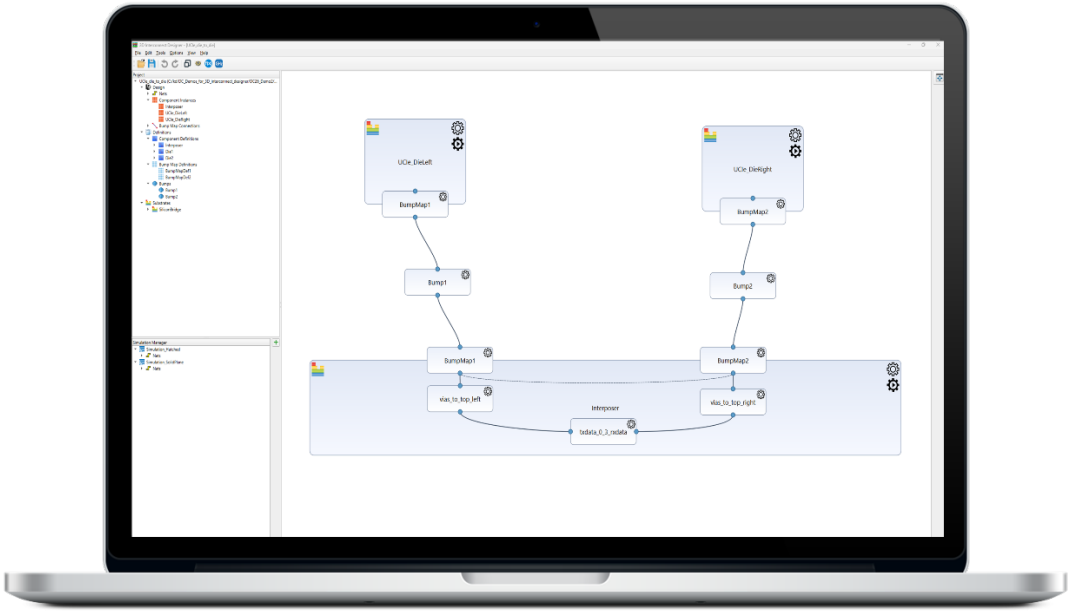


Figure 1. 3D Interconnect Designer

Turn Early Insight into Competitive Advantage

By introducing physically grounded insight during the architecture phase, 3D Interconnect Designer enables teams to shift risk discovery to the earliest and most flexible stage of development. Instead of uncovering impedance mismatches, coupling effects, or return path discontinuities after layout, when changes are expensive, engineering teams can identify and resolve these issues during architectural exploration.

This early validation helps:

- Reduce costly architecture-to-layout iteration cycles
- Improve collaboration between architecture, SI, and packaging teams
- Explore more design alternatives in less time
- Increase confidence in advanced 2.5D and 3D interconnect implementations

The result is a more predictable development cycle and a faster path to market for advanced 2.5D and 3D interconnect design.

3D Interconnect Designer is available as an independent software solution and does not require a full ADS environment. Licensing options and configurations are available separately.

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