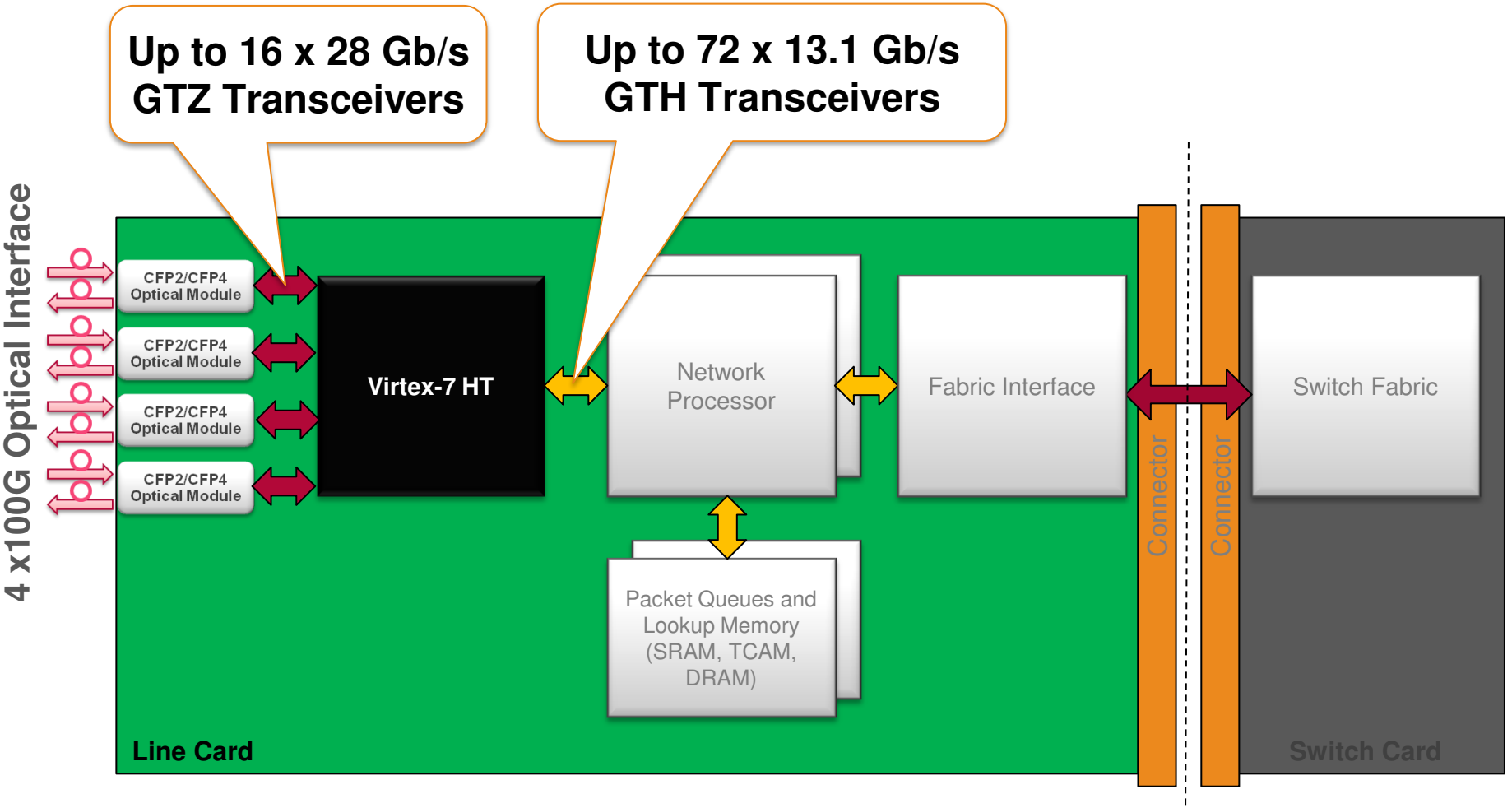
FPGAs with 28Gb/s Transceivers Built with Heterogeneous Stacked-Silicon Interconnects

Ephrem Wu and Suresh Ramalingam

Outline

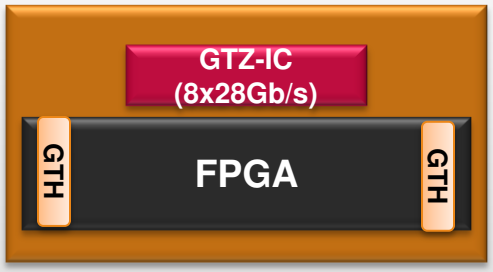
1. Key Application
2. Heterogeneous Stacked-Silicon FPGA Family
3. Stacked-Silicon Packaging
4. Two Types of Stacked-Silicon Interconnects

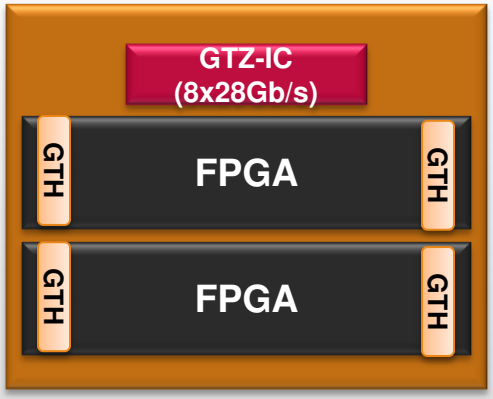
400Gb/s Line Card Application

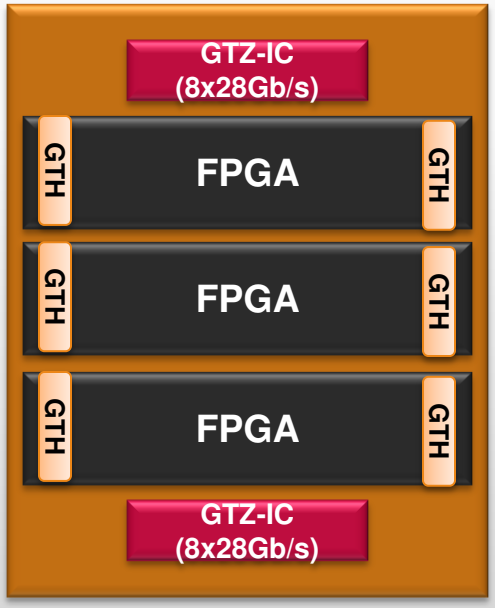


Heterogeneous Stacked-Silicon FPGAs

Interposer Floorplans



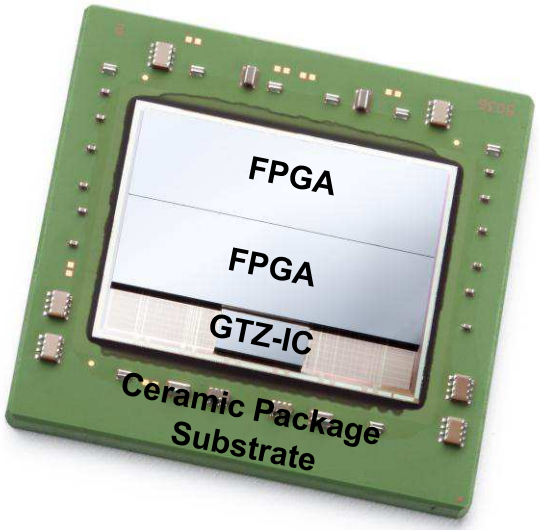




	XC7VH290T	XC7VH580T	XC7VH870T
Network	2 x 100 Gb/s	2 x 100 Gb/s	4 x 100 Gb/s
GTZ (28G)	8	8	16
GTH (13G)	24	48	72

XC7VH580T Under the Hood

Industry's First Heterogeneous FPGA



XC7VH580T Under the Hood

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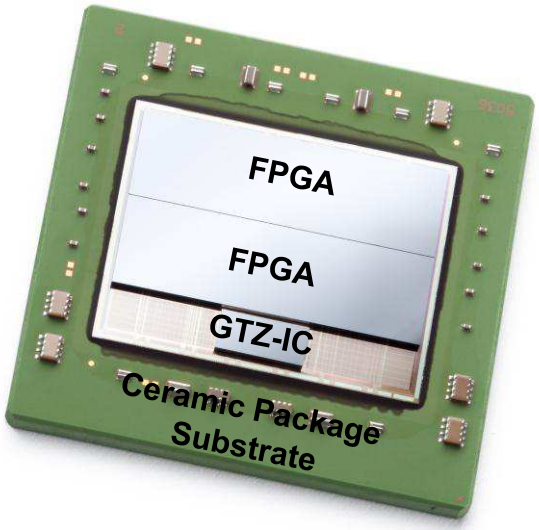

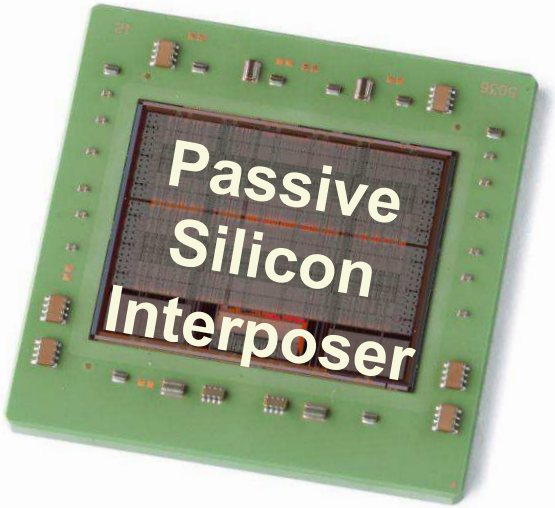

XC7VH580T Under the Hood

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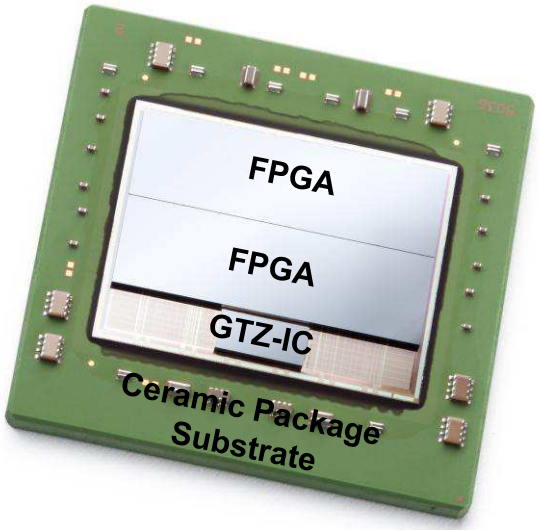
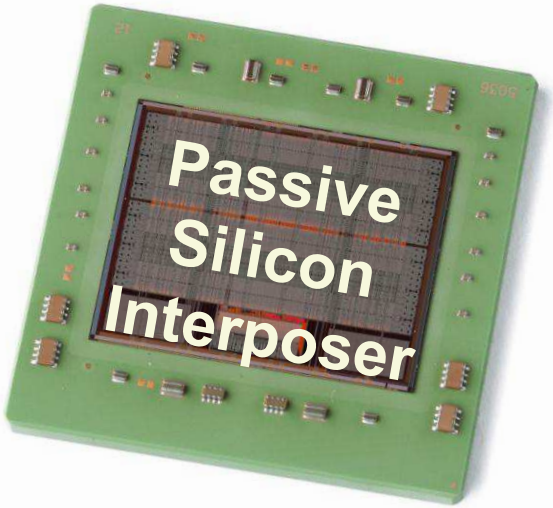
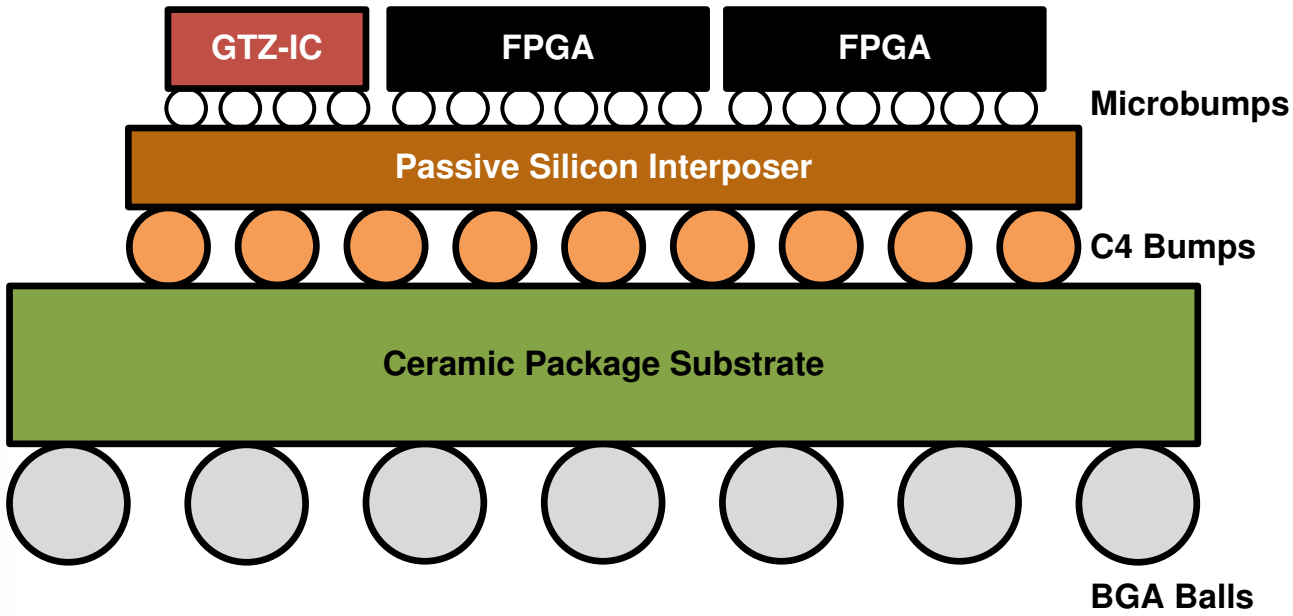
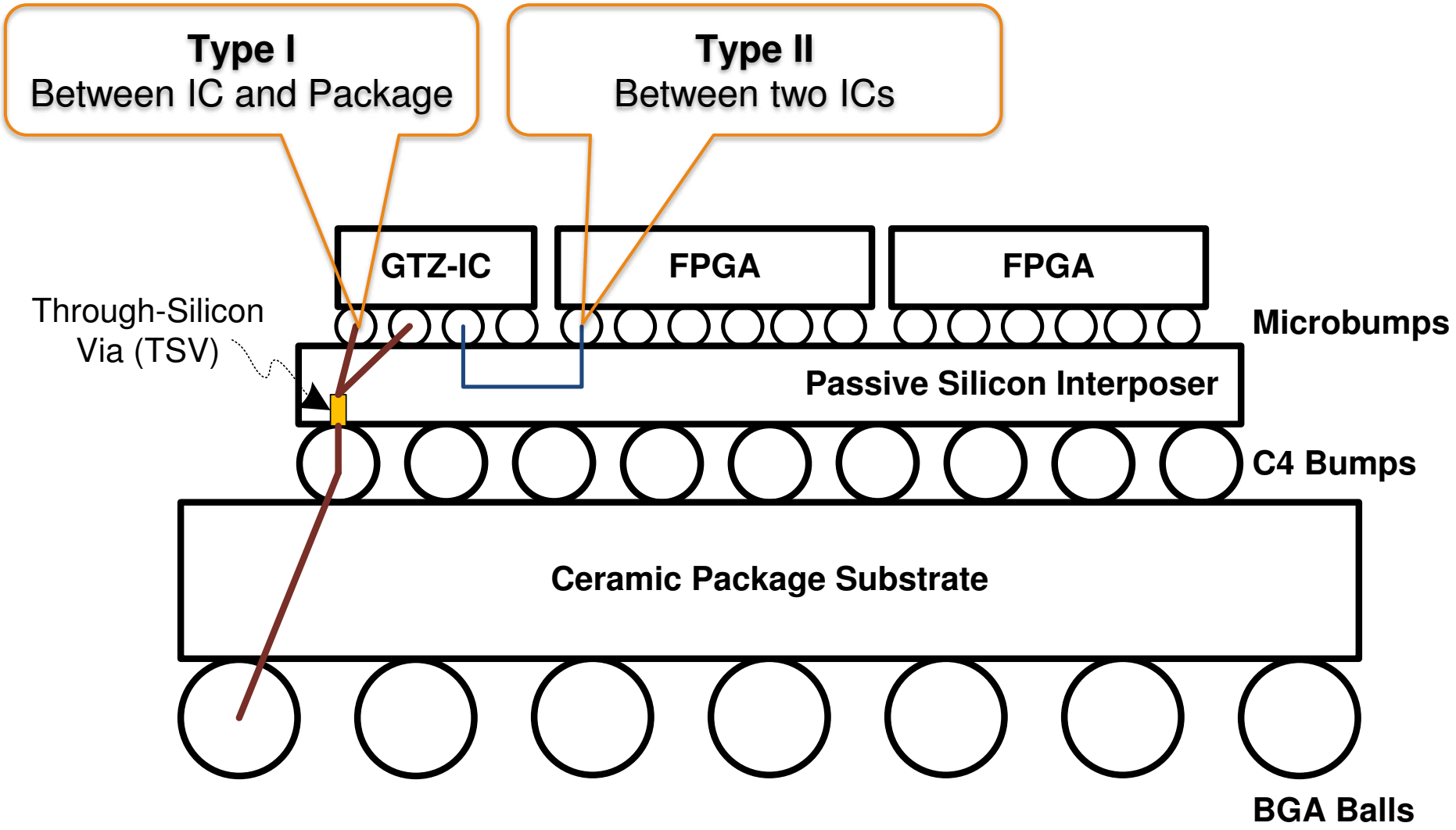


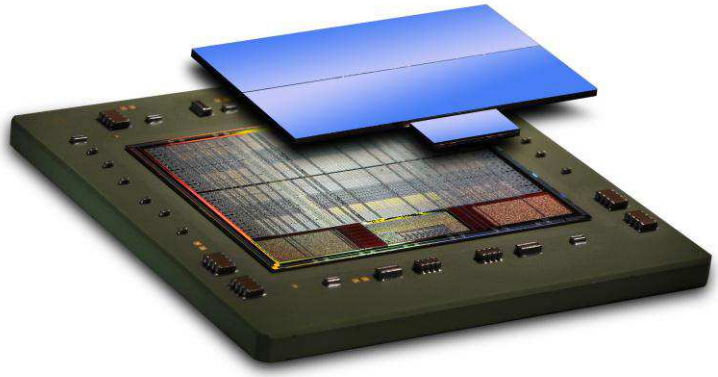




Two Interconnect Types



Packaging, Assembly, and Test



Top Dice, Interposer, & Package

XILINX

28nm FPGA & Interposer

tsmc

Package Substrate

KYOCERA

µBump, Die separation
Joining, & Assembly

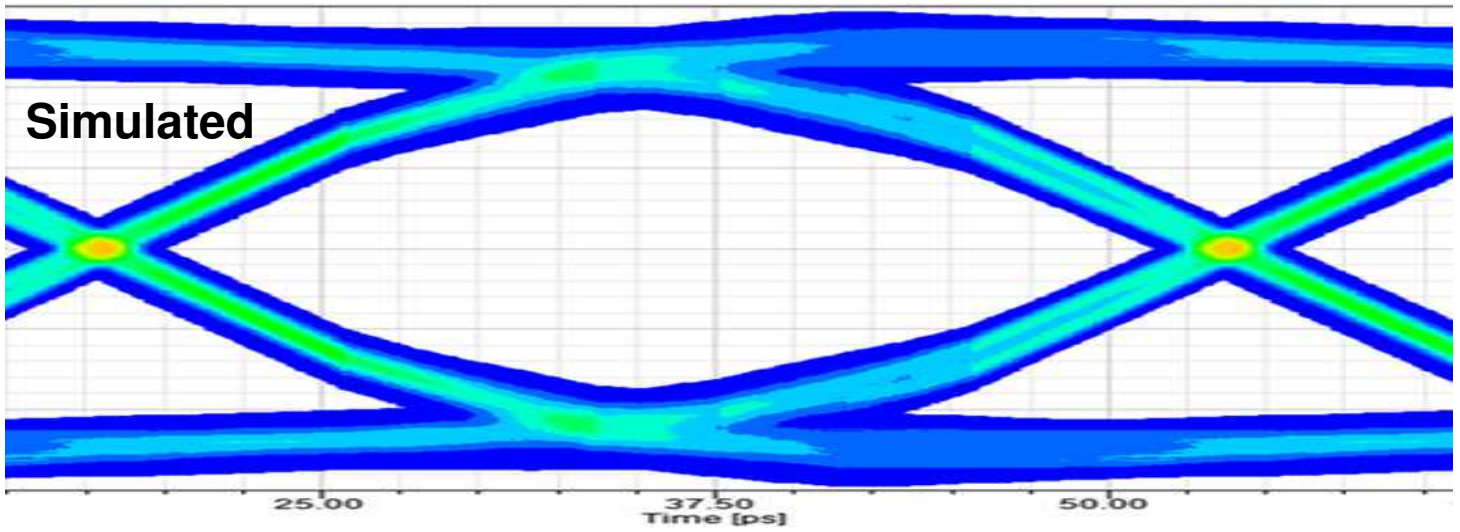
Amkor Technology

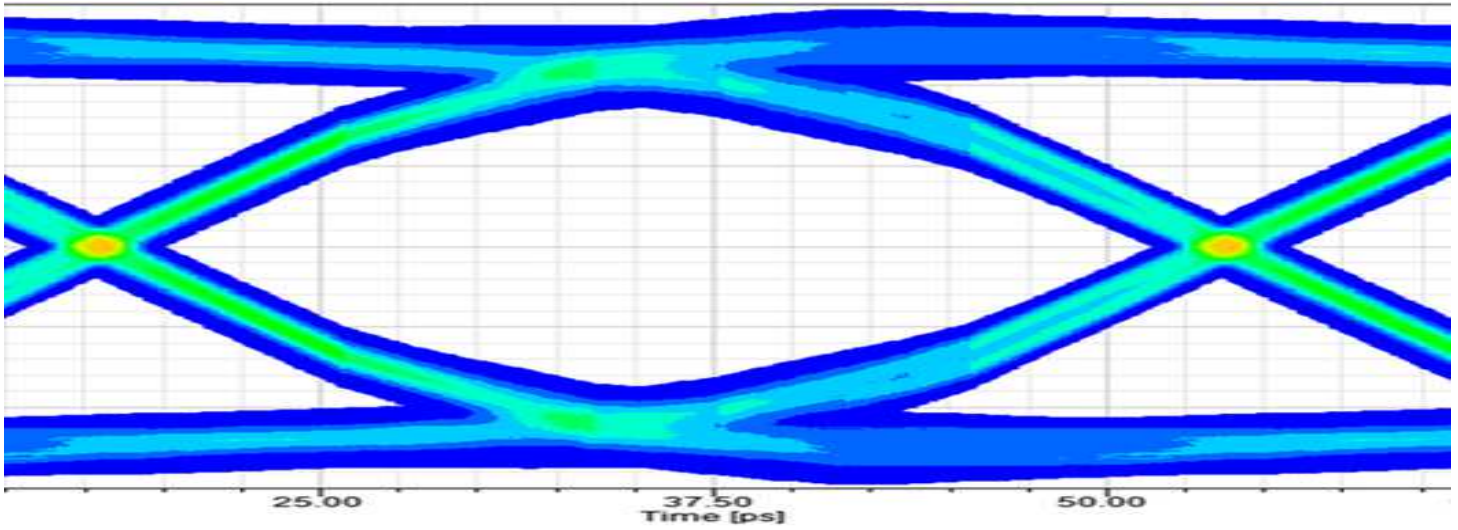
tsmc

Final Test of Packaged Part

XILINX

Type I Example: 28 Gb/s Serial Transmitter





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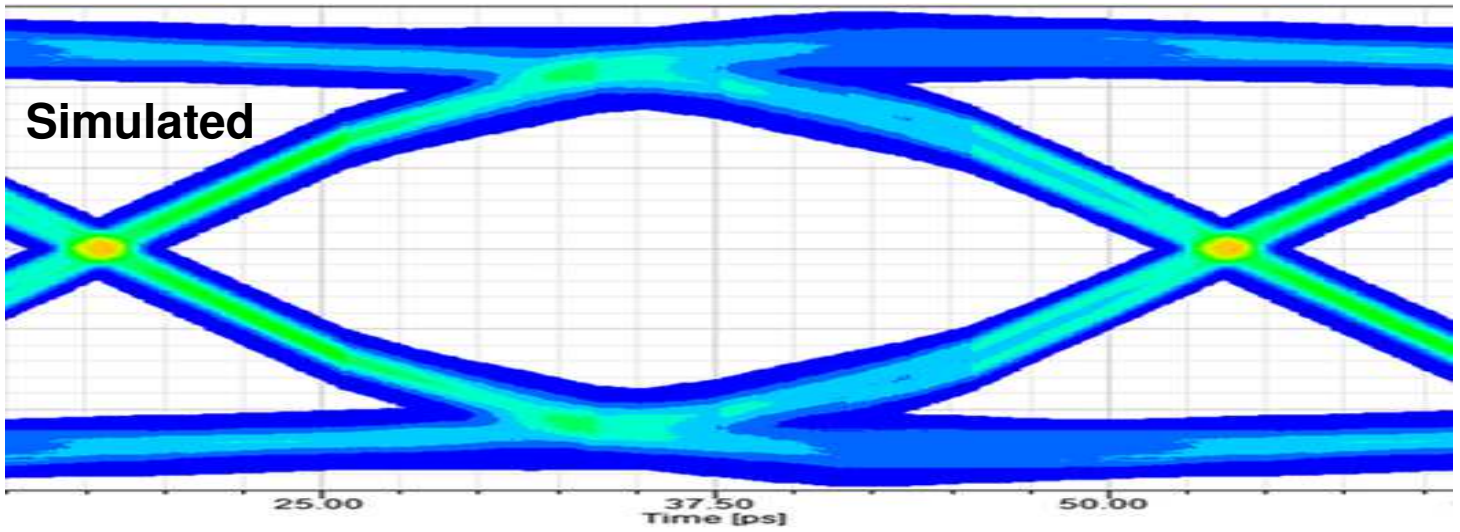
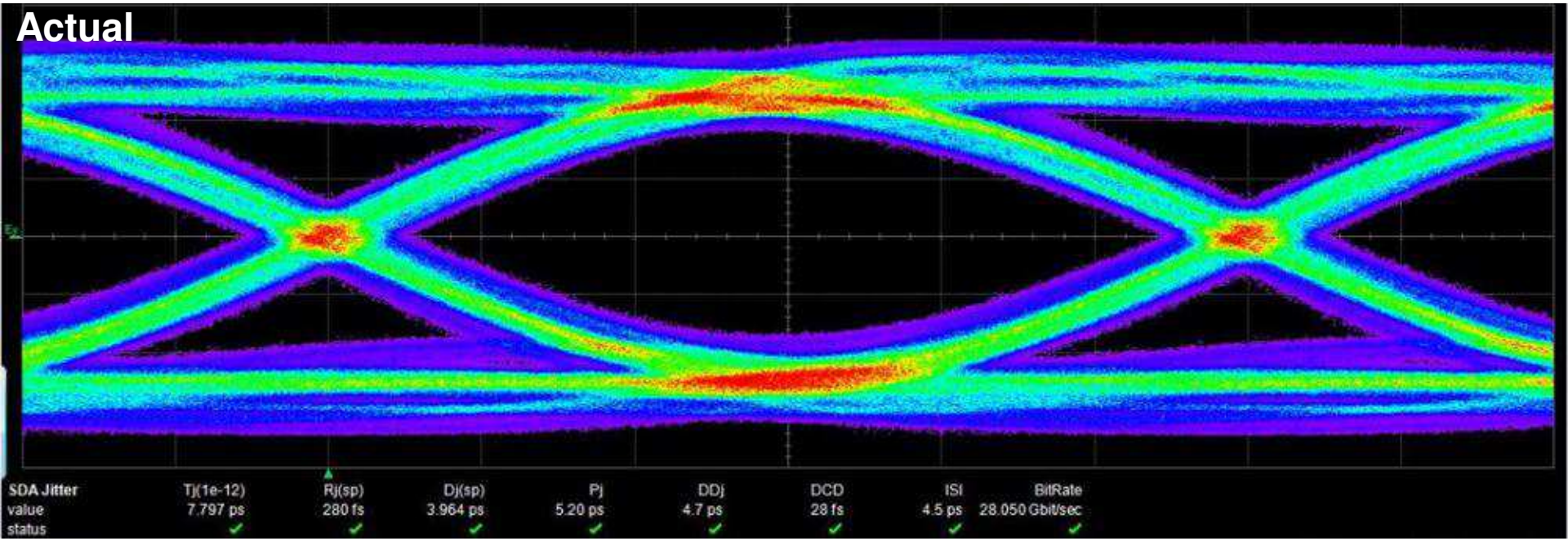
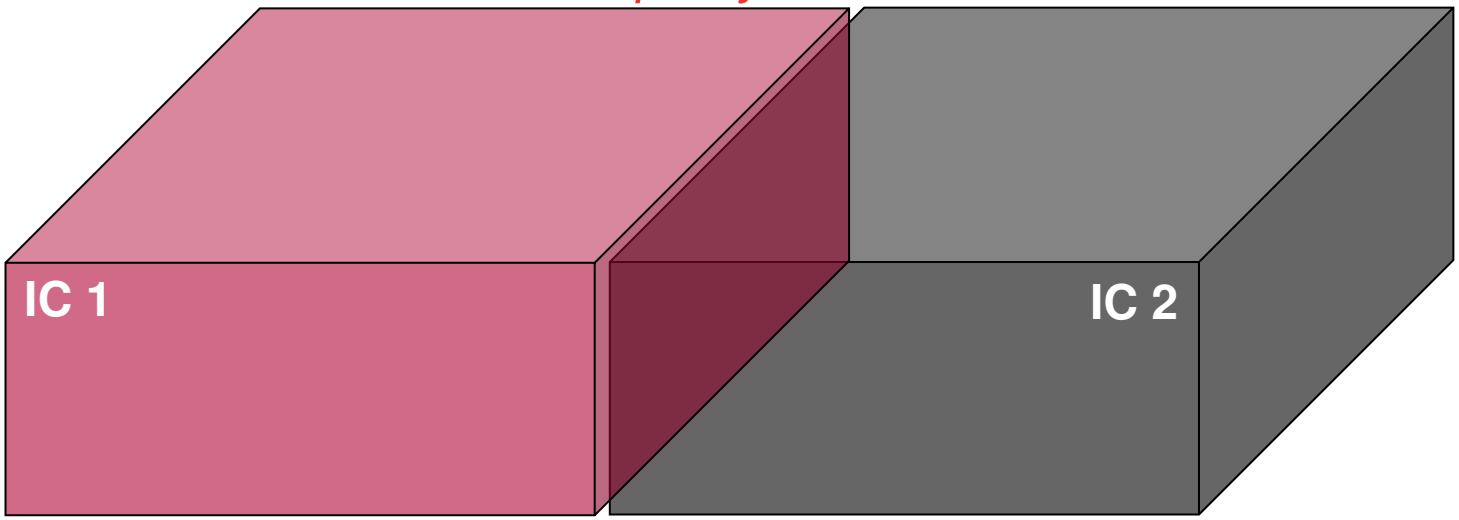




Type II Interconnects

Inter-IC Interconnect Microstrip Layout with Side Shields



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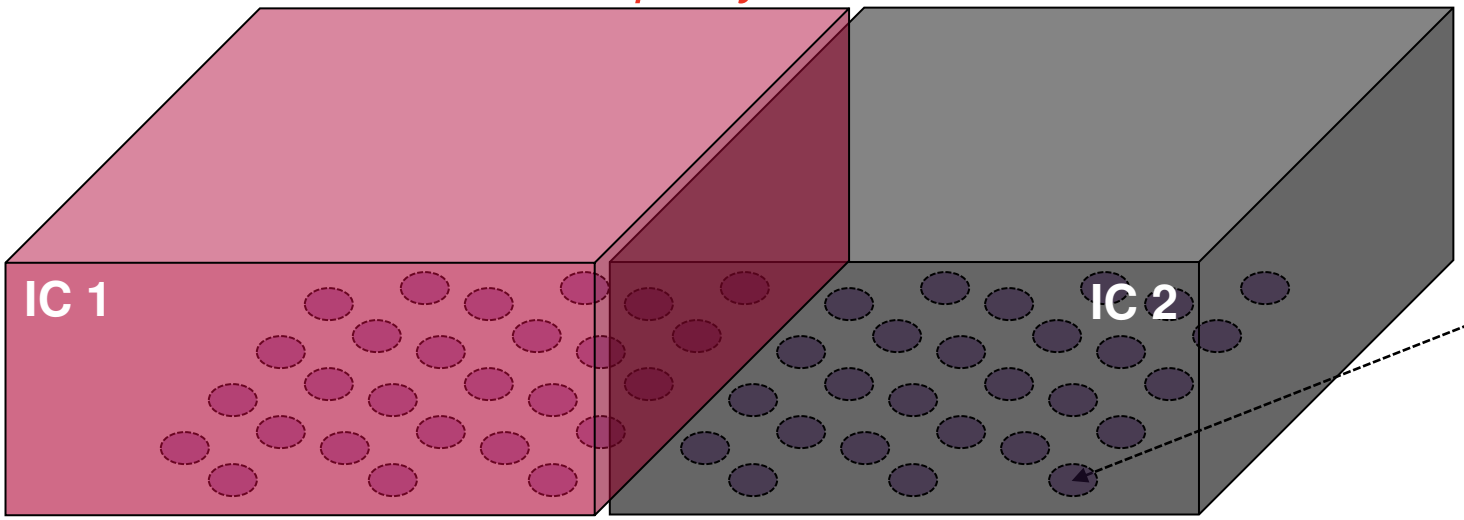

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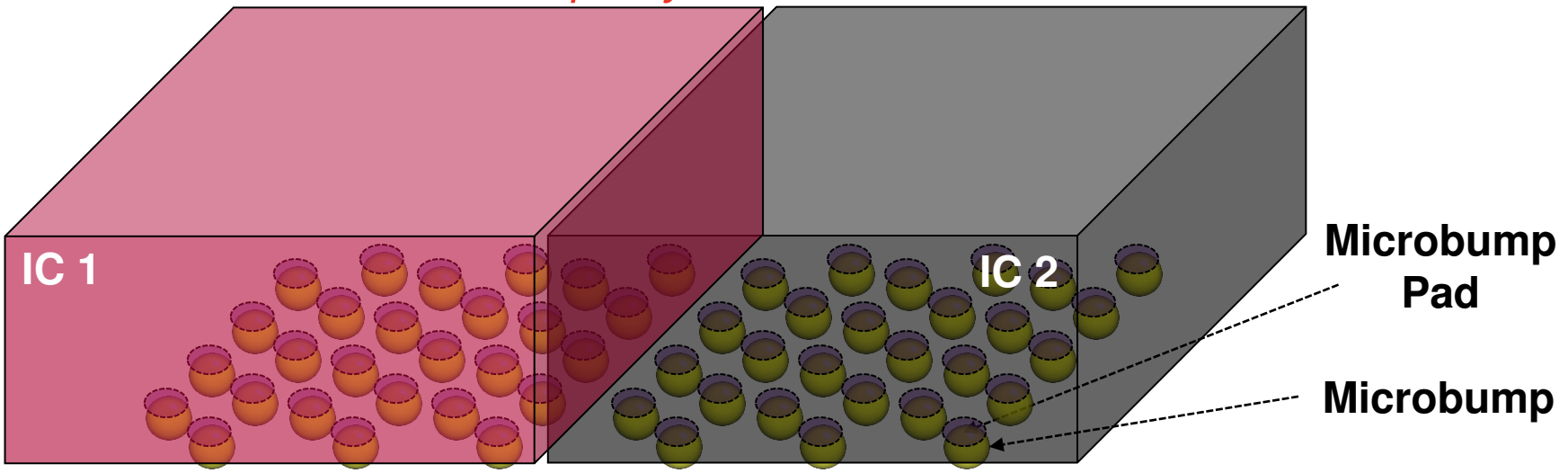

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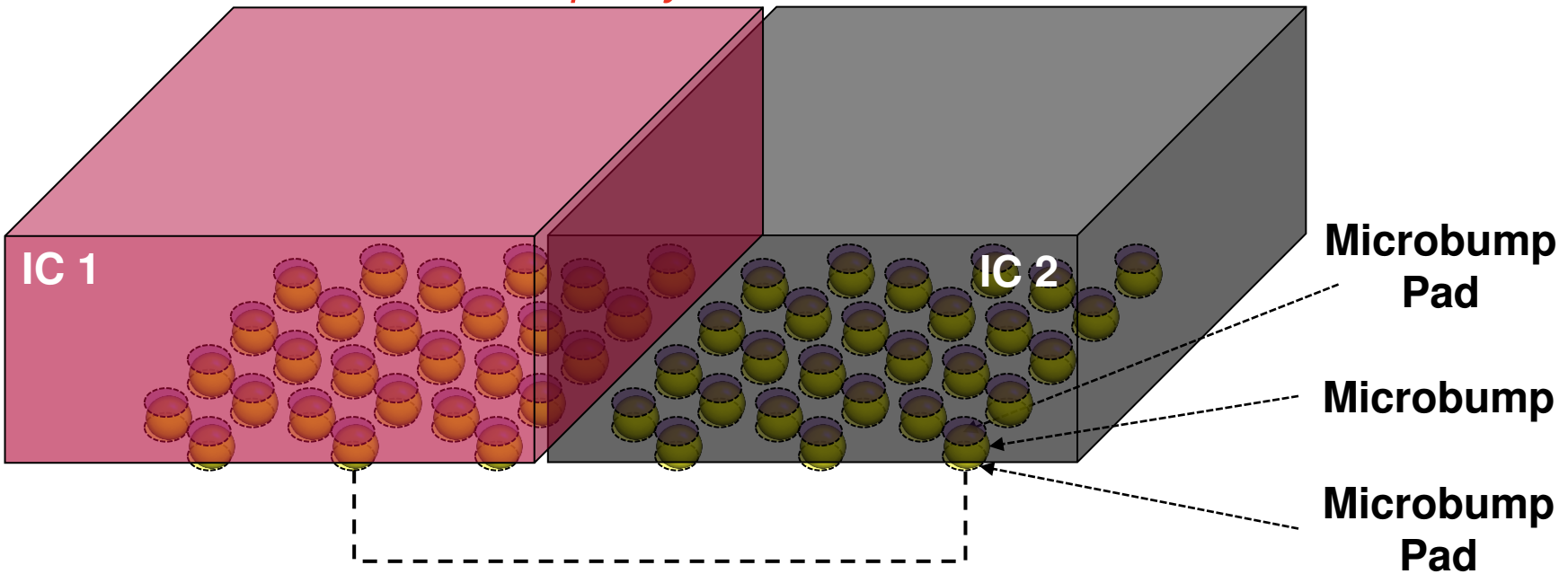

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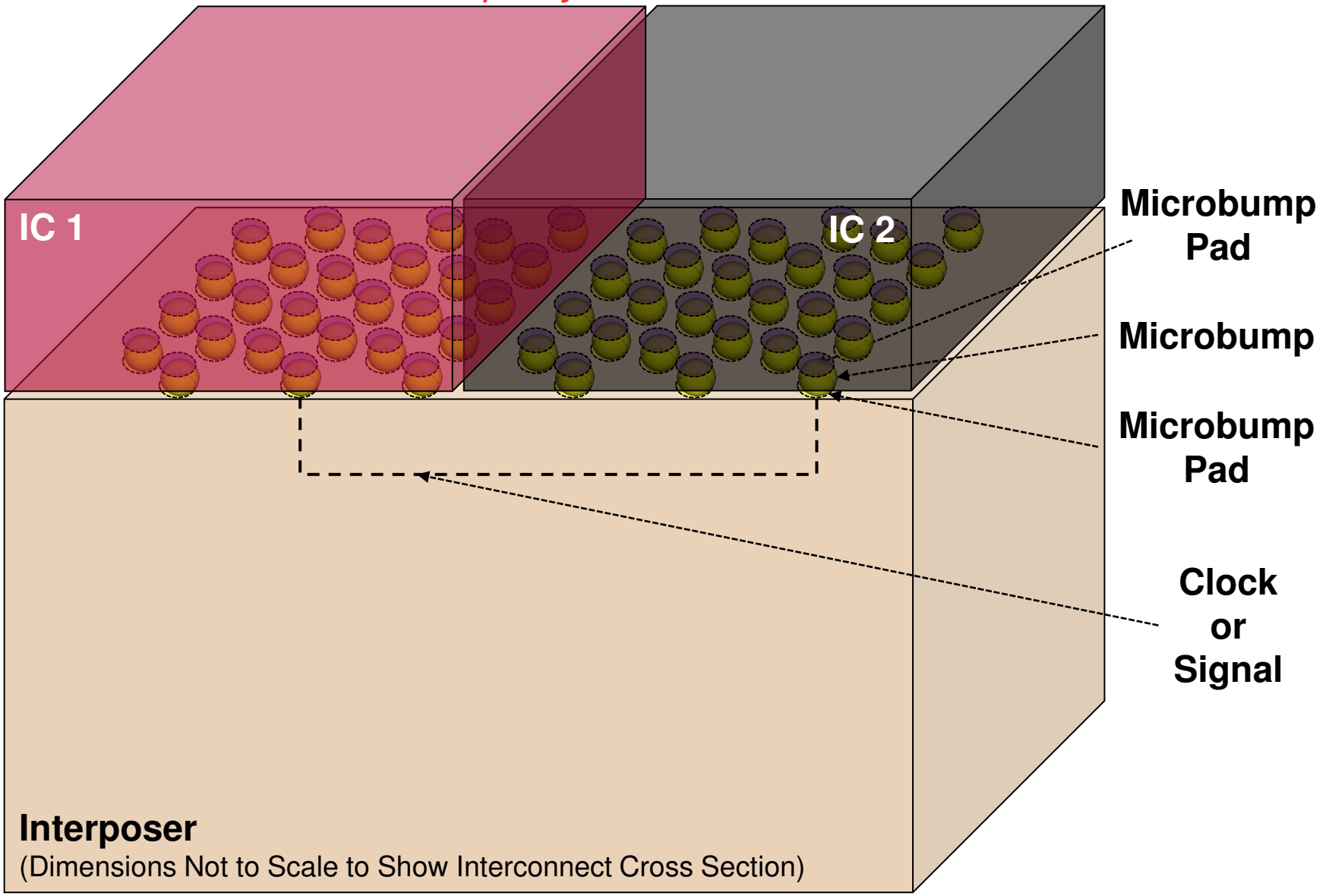

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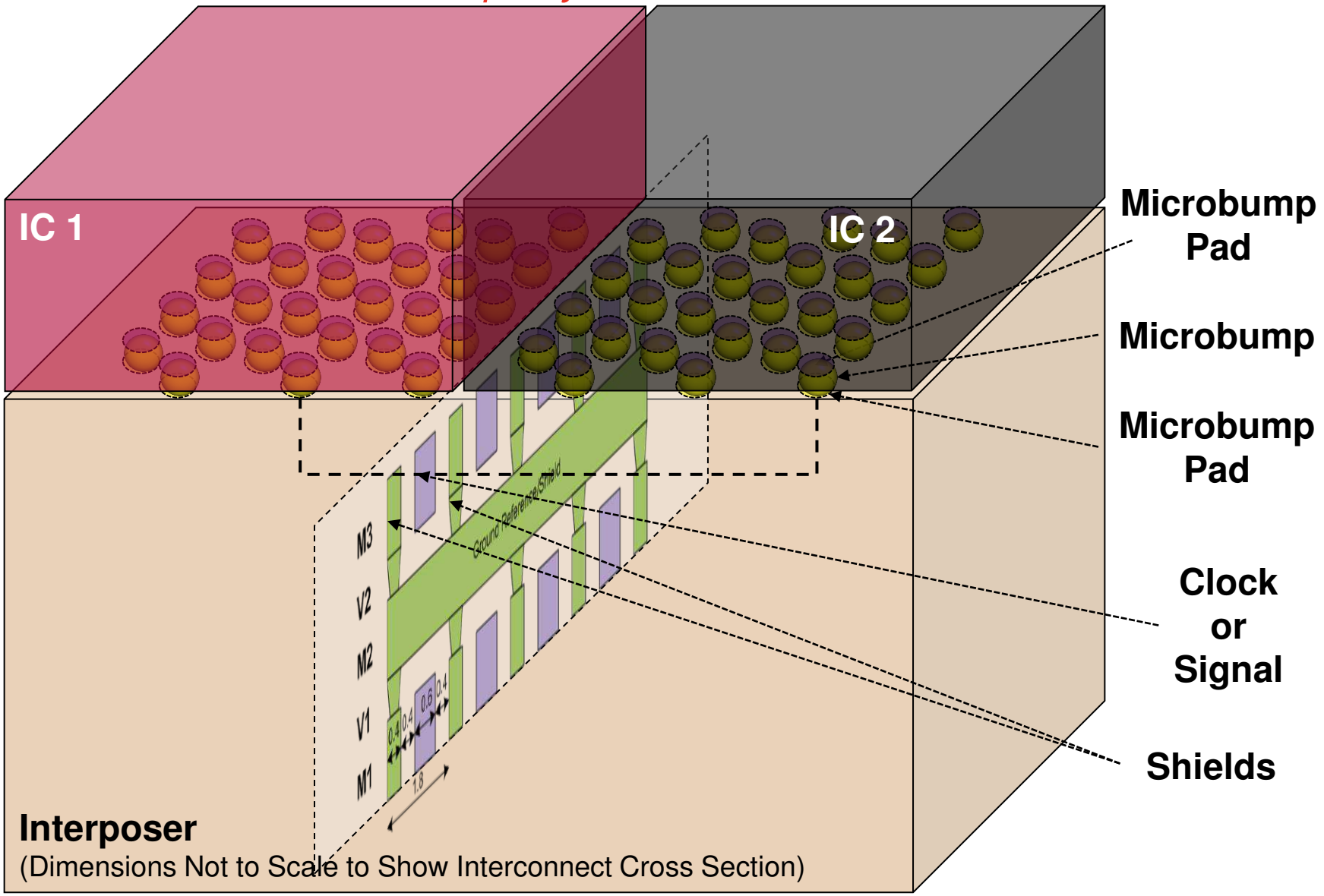
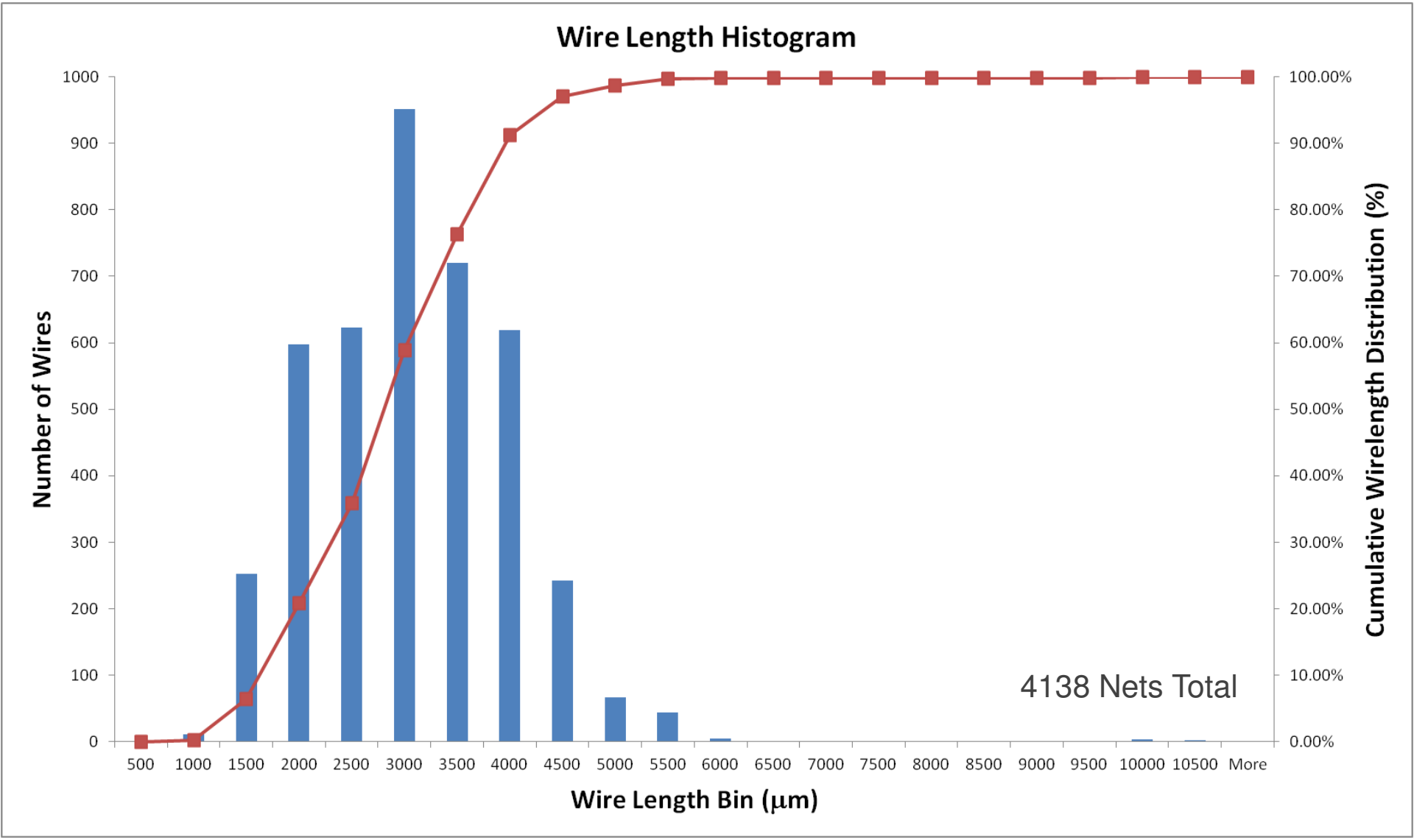


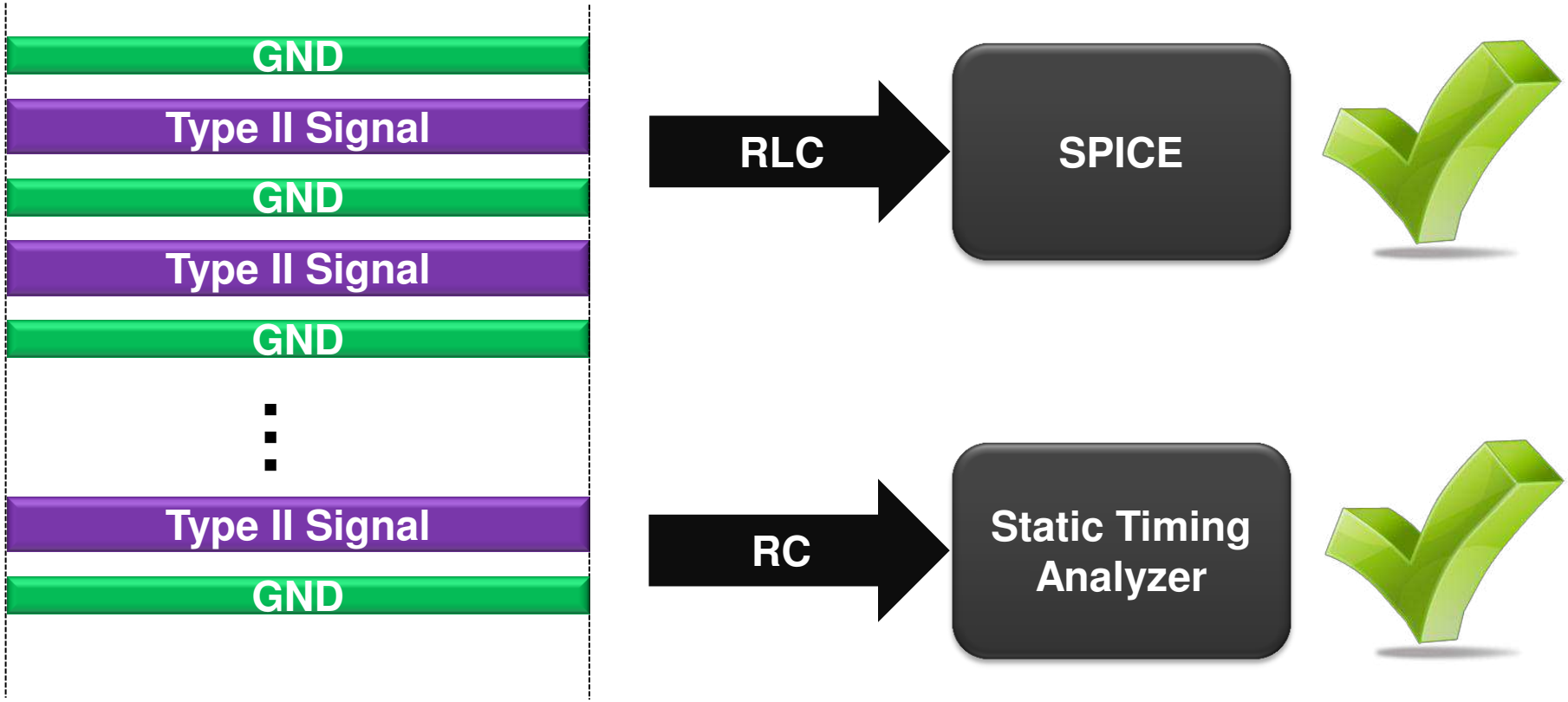
Wire Length Distribution

Between GTZ-IC and FPGA



RC Static Timing Analysis for Productivity

Calibrated RC-Based STA Against RLC-Based SPICE



Summary

1. Presented industry's first heterogeneous 3D FPGA.
2. FPGA & GTZ-IC create three scalable products.
3. Reviewed stacked-silicon packaging & supply chain.
4. Showed Type I signaling: 28 Gb/s TX over TSVs.
5. Lacked 3D timing tools for Type II signals.
   Leveraged STA tools calibrated with RLC SPICE runs.