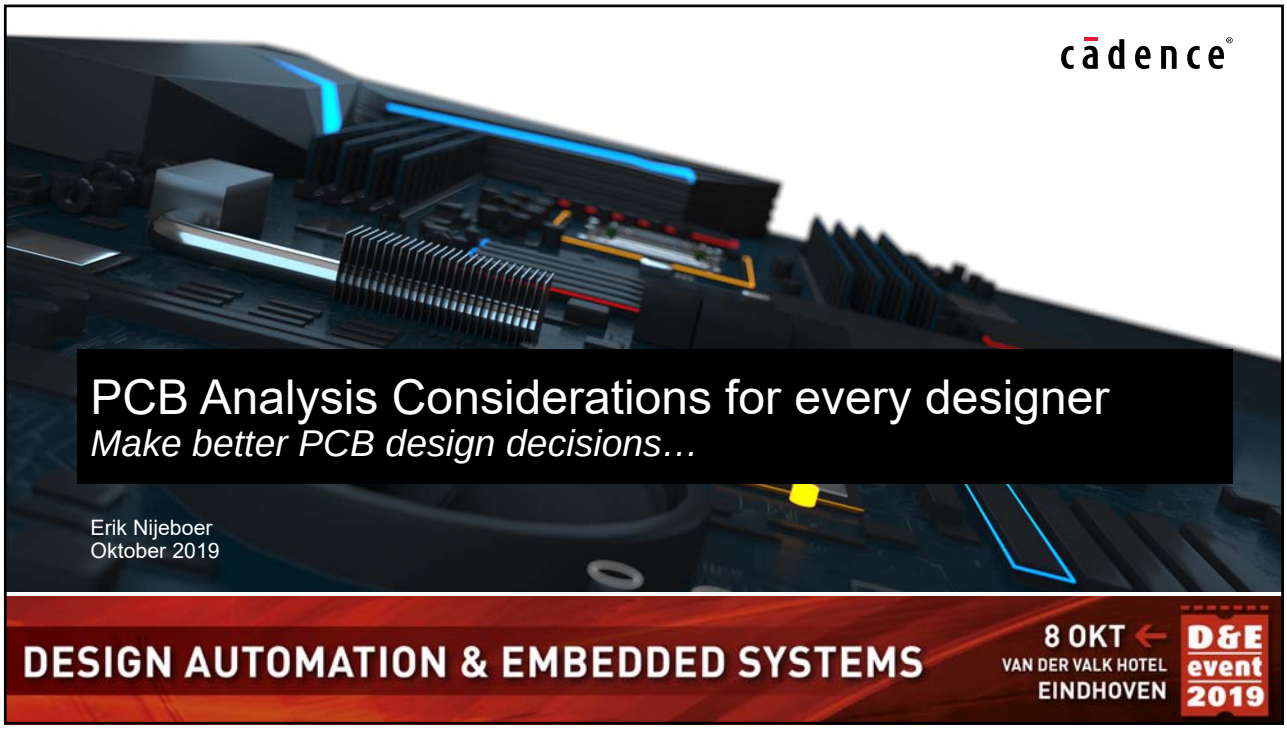


1

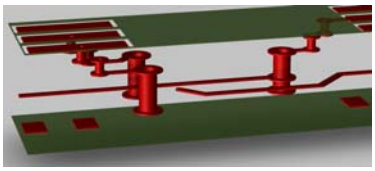
Introduction

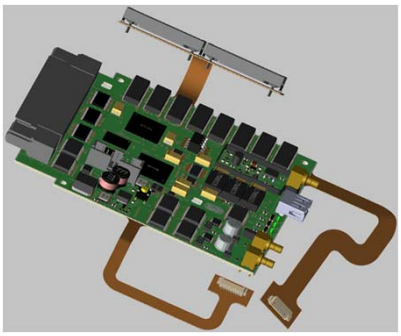
- Increasing PCB complexity
- Robust board performance
  - Manufacturability
  - Electrical Analysis
  - Thermal Analysis

2

Increasing PCB Complexity

- Flex-Rigid
- High-density interconnect (HDI)
  - Microvias
  - Blind/Buried, staggered vias
- BGAs
- ECAD-MCAD codesign



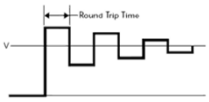


80% 20%

% time spent on designing medium to high complexity PCBs*

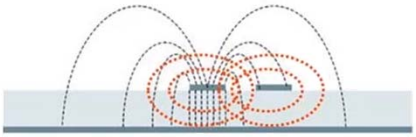
Increasing PCB Complexity

- Constant Impedance

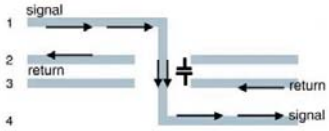


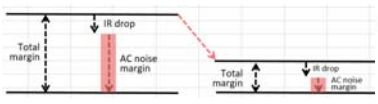
- Coupling issues between adjacent “fast” signals

- Return path discontinuities



- IR-drop





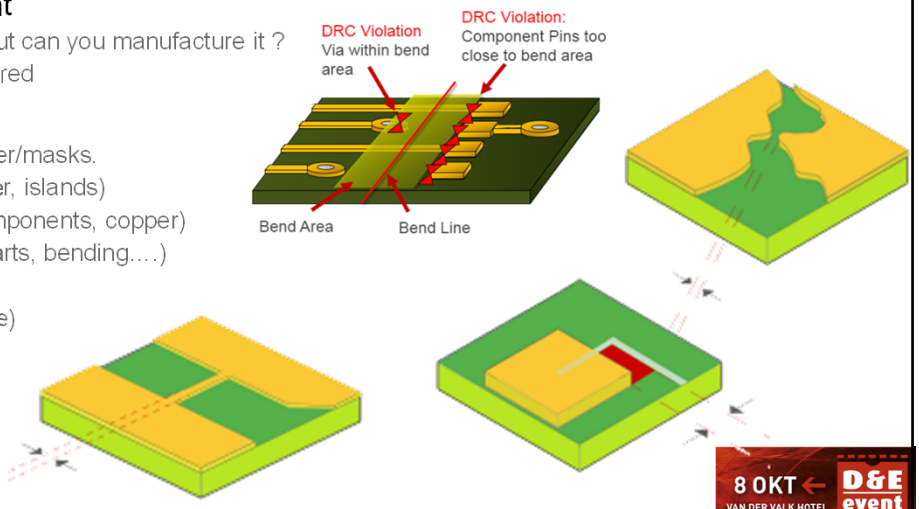
- Thermal effects

How ensure board performance ?

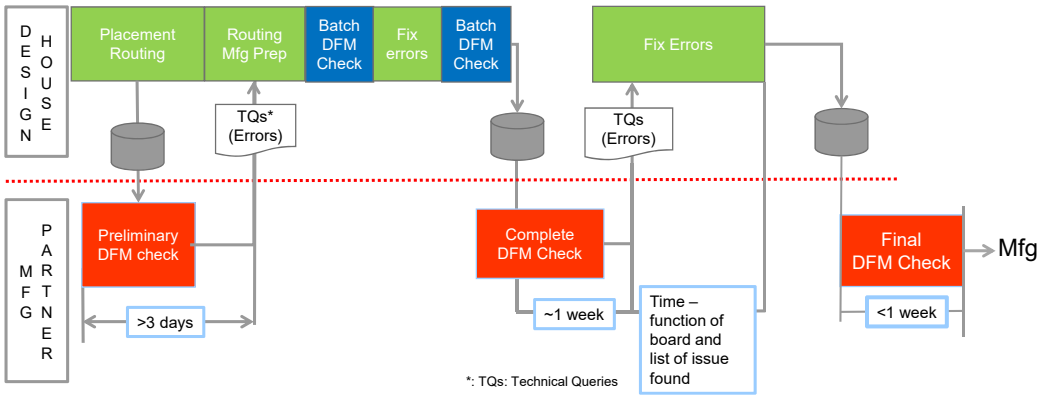
- Manufacturability
- Electrical Analysis
- Thermal Analysis

Design for Manufacturing/Assembly

- DFx rules are important
  - You can design anything but can you manufacture it ?
  - Bare minimum that is required
- Example rules/checks
  - Minimum spacing for copper/masks.
  - Minimum copper size (sliver, islands)
  - Spacing board outline (components, copper)
  - Flex Rigid (vias, copper, parts, bending….)
  - Acid traps (sharp angles)
  - Copper balancing (warpage)
  - Testpoints
    - Spacing (testpoint, masks)
    - Pad size



Design for Manufacturing Rules



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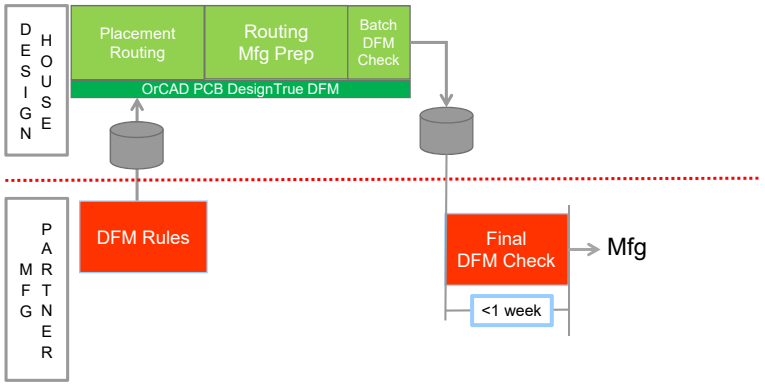
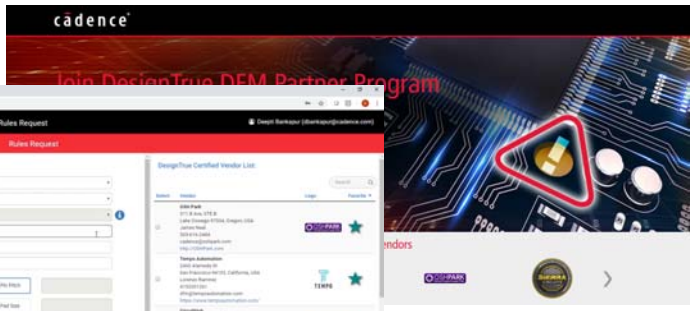
Design for Manufacturing Rules

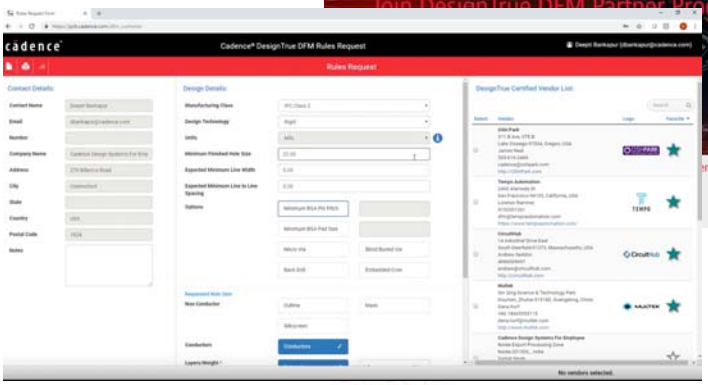


8

How to get DFx rules

- If possible, get rules from your manufacturer
- Use industry standards or guidelines
- Cadence DesignTrue DFM portal
  - EMS can register here





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How ensure board performance ?

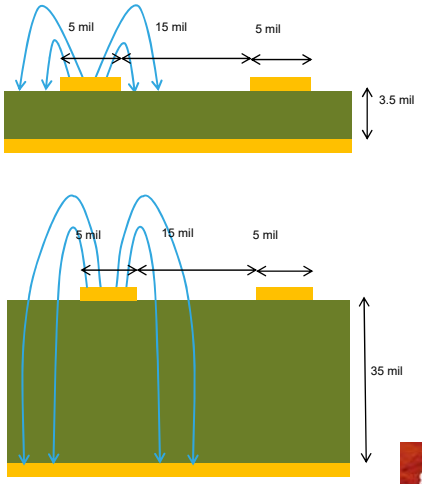
- Manufacturability
- Electrical Analysis
- Thermal Analysis

10

Existing PCB SI Related Constaints

Not electrical aware !!

- Spacing and trace width

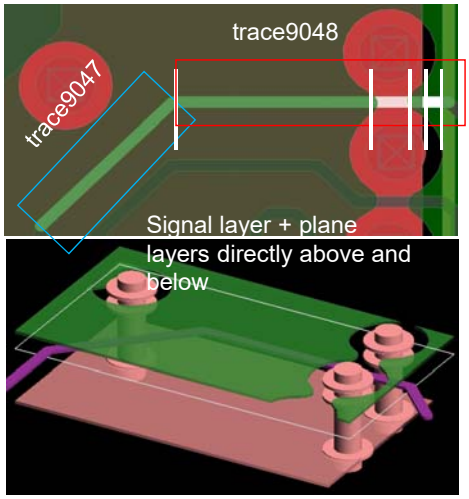


11

Existing PCB SI Related Constaints

Not electrical aware !!

- Spacing and trace width
- Impedance

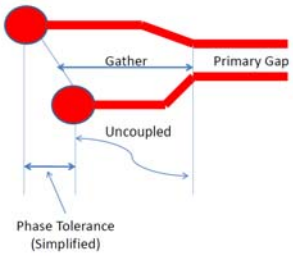


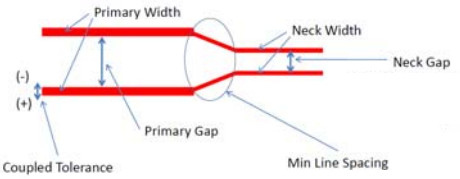
12

Existing PCB SI Related Constaints

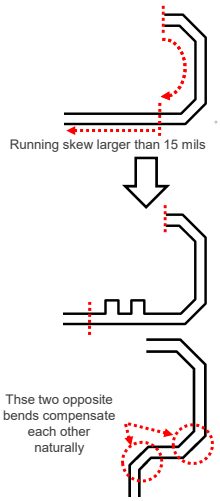
Not electrical aware !!

- Spacing and trace width
- Impedance
- Differential Pair





Static or Dynamic Phase



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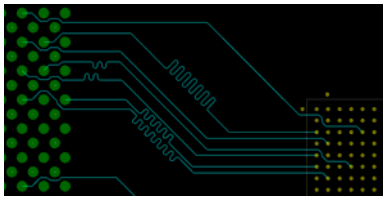
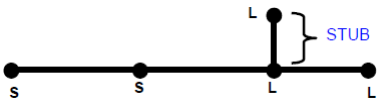
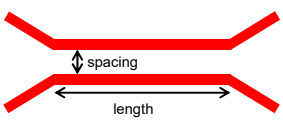
Existing PCB SI Related Constaints

- Spacing and trace width
- Impedance
- Differential Pair
- Relative propagation delay
  - In time or length
- Number of vias
- Stubs
- Max parallel lines







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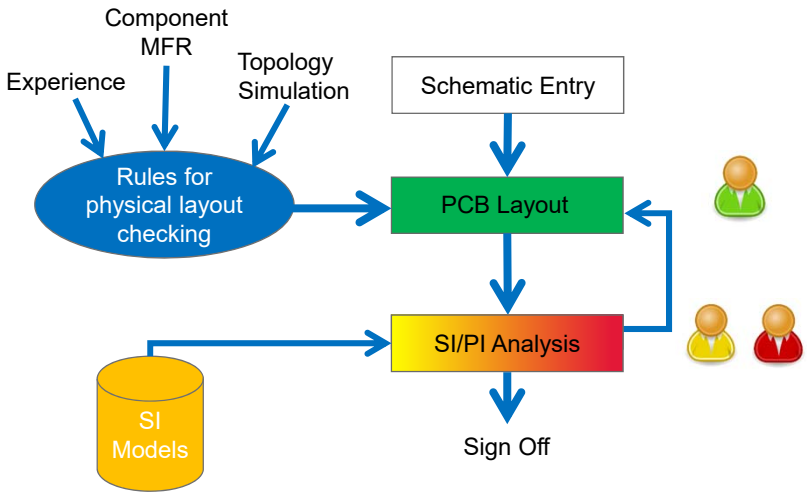
Common PCB flow



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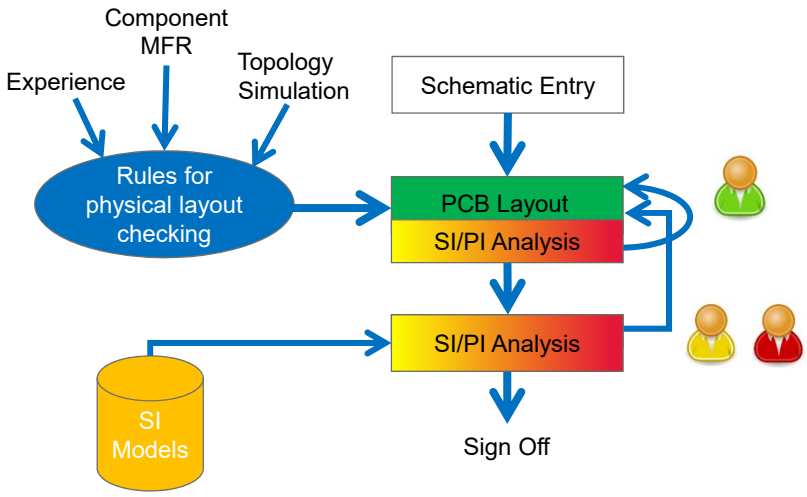
Required PCB flow



- ✓ Faster Feedback
- ✓ Eases SI/PI expert tasks

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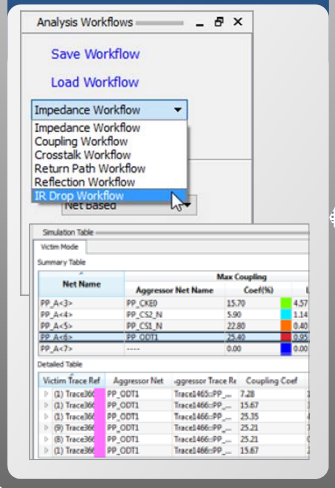
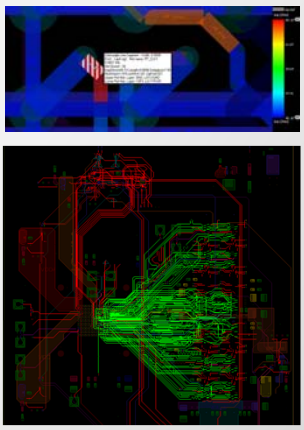
In Design and Analysis

OrCAD PCB Editor

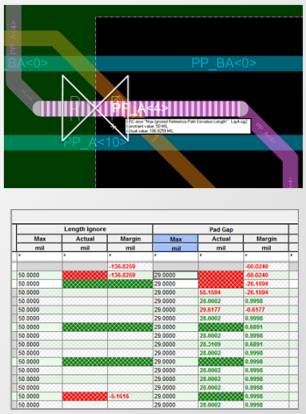
Analysis Workflows



Visions



Advanced ERCs



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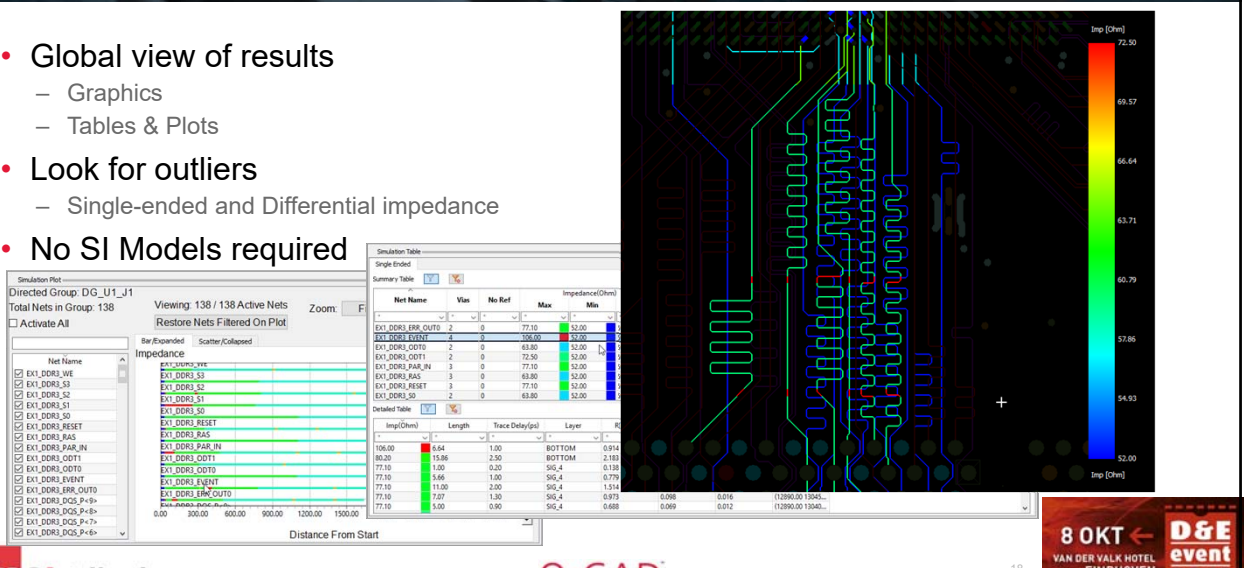
Impedance Analysis Screening

- Global view of results
  - Graphics
  - Tables & Plots
- Look for outliers
  - Single-ended and Differential impedance
- No SI Models required



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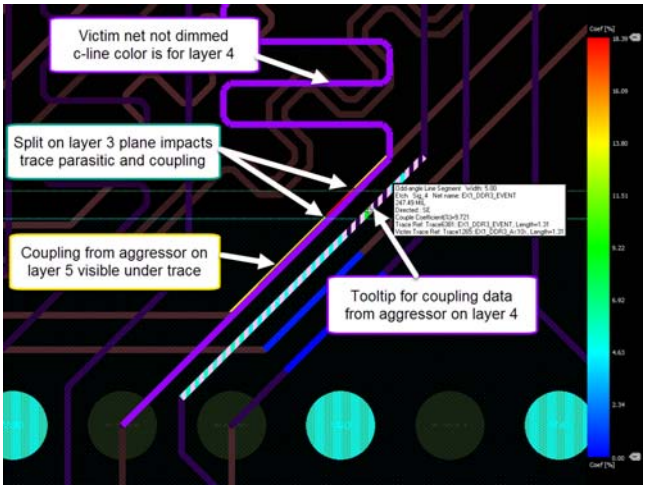
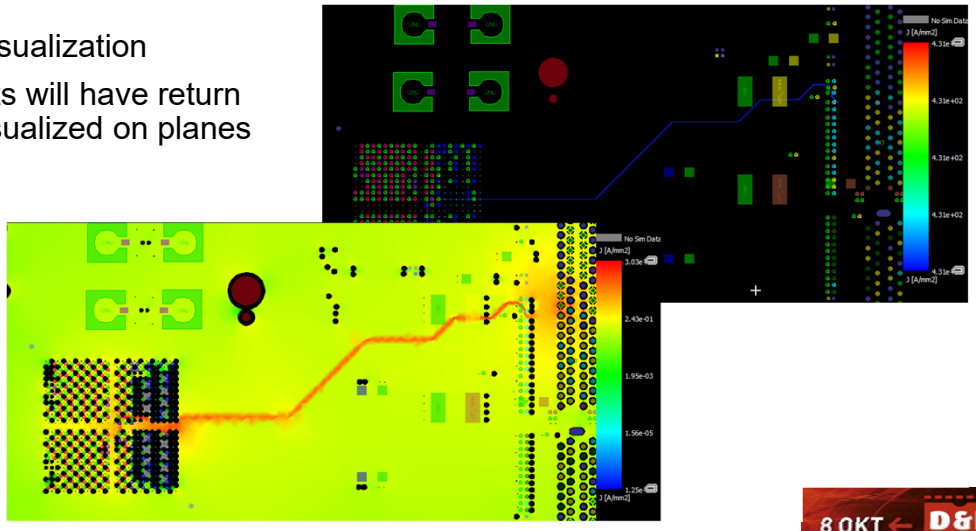
Coupling Analysis Screening

- Electrical coupling is more accurate than geometrical methods
- Supports a victim and worst case mode
- No SI models required



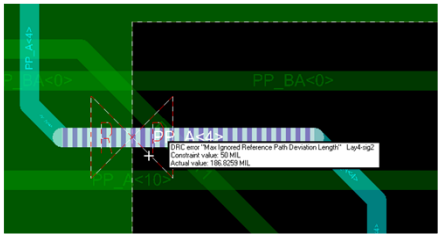
Return Path Analysis

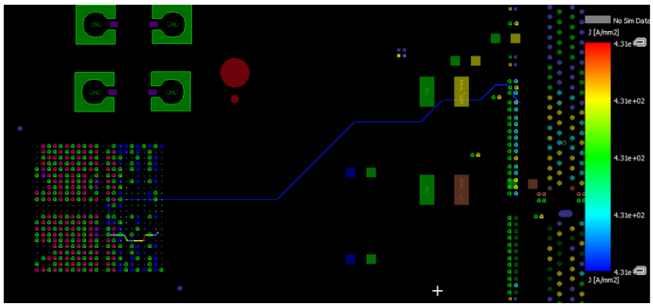
- Return Path Visualization
- Selected results will have return current flow visualized on planes
- No Models



Return Path Analysis

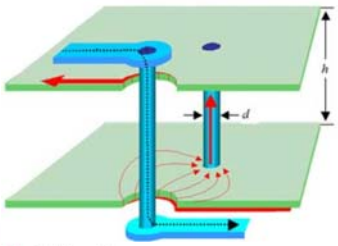
- Return Path Visualization
- Selected results will have return current flow visualized on planes
- No Models
- DRC for return path (deviation)

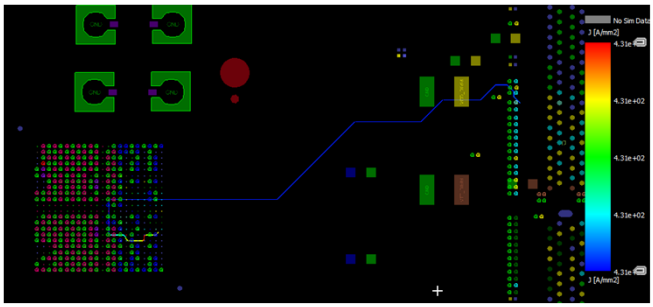




Return Path Analysis

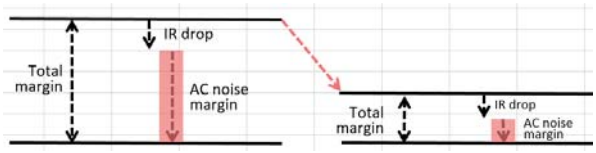
- Return Path Visualization
- Selected results will have return current flow visualized on planes
- No Models
- DRC for return path (deviation)
- Insert return path vias





IR Drop Analysis

- IR Drop can cause
  - Chips not powered up properly
  - Smaller noise margin for chip to become unreliable
  - Higher current density to introduce thermal issues
- IR Drop analysis allows layout designers to catch these problems early in the design cycle



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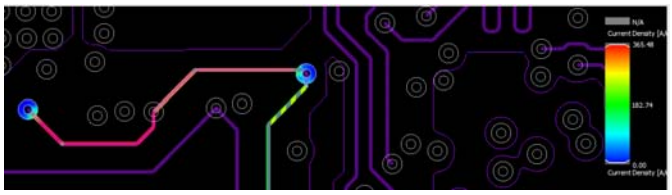

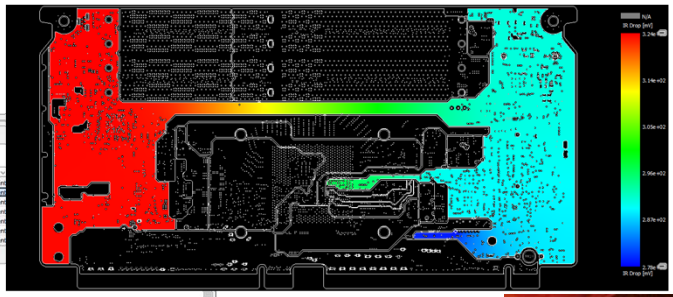

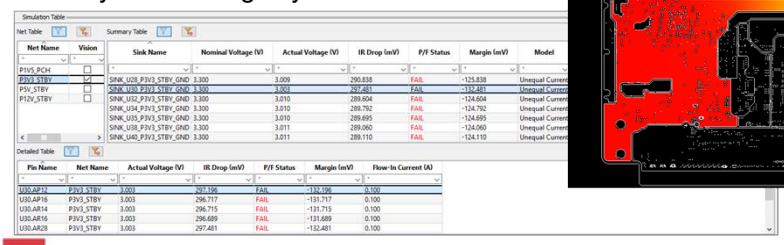

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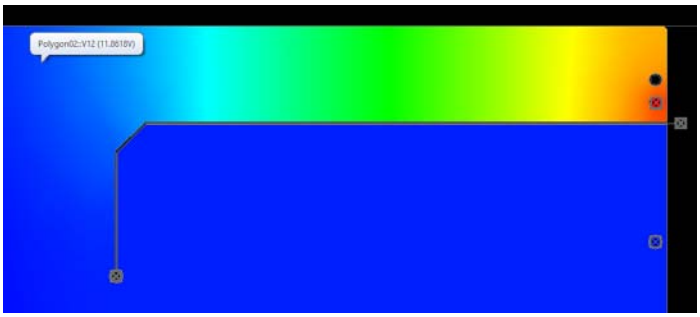

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IR Drop Analysis

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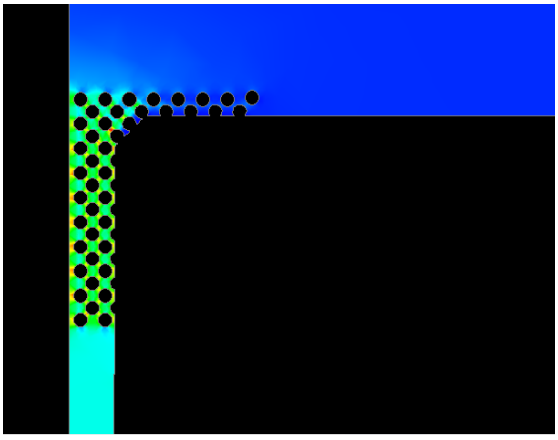

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How ensure board performance ?

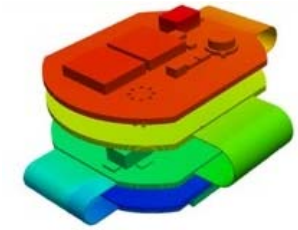
- Manufacturability
- Electrical Analysis
- Thermal Analysis

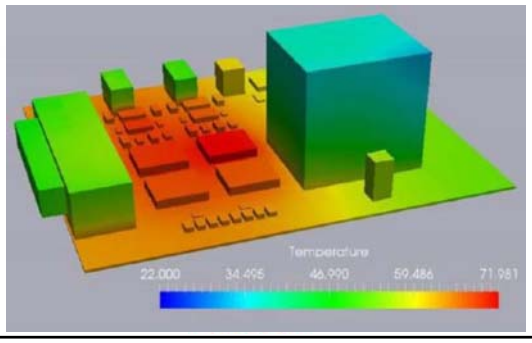
Thermal effects

- Resistance of copper goes up
  ~30% at 80°C
- Component speeds slows down
- Material loss
- Power loss
- Reduce signal transmission

Thermal Analysis

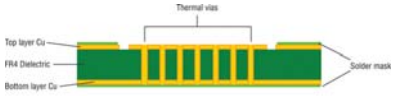
- IR drop Electrical/Thermal Co-simulation
  - Component heating (power dissipation), including heatsinks
  - Joule heating (PCB copper)
  - Airflow
  - Heatmap
- Heat Transfer Map from Computational Fluid Dynamics (CFD) simulation.

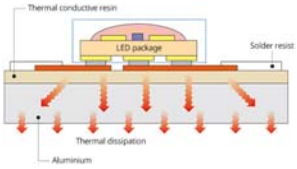




Solve Thermal issues

- Thermal vias
- Heatsink
  - Thermal pads
- Cooling fans
- Stackup
  - Add powerplanes
  - Ceramic substrates
  - Metal core





Conclusion

To ensure PCB performance use an optimized PCB flow:

- Real time DFx rules
- In Design Analysis for screening for SI/PI issues
- Electrical and thermal co-analysis

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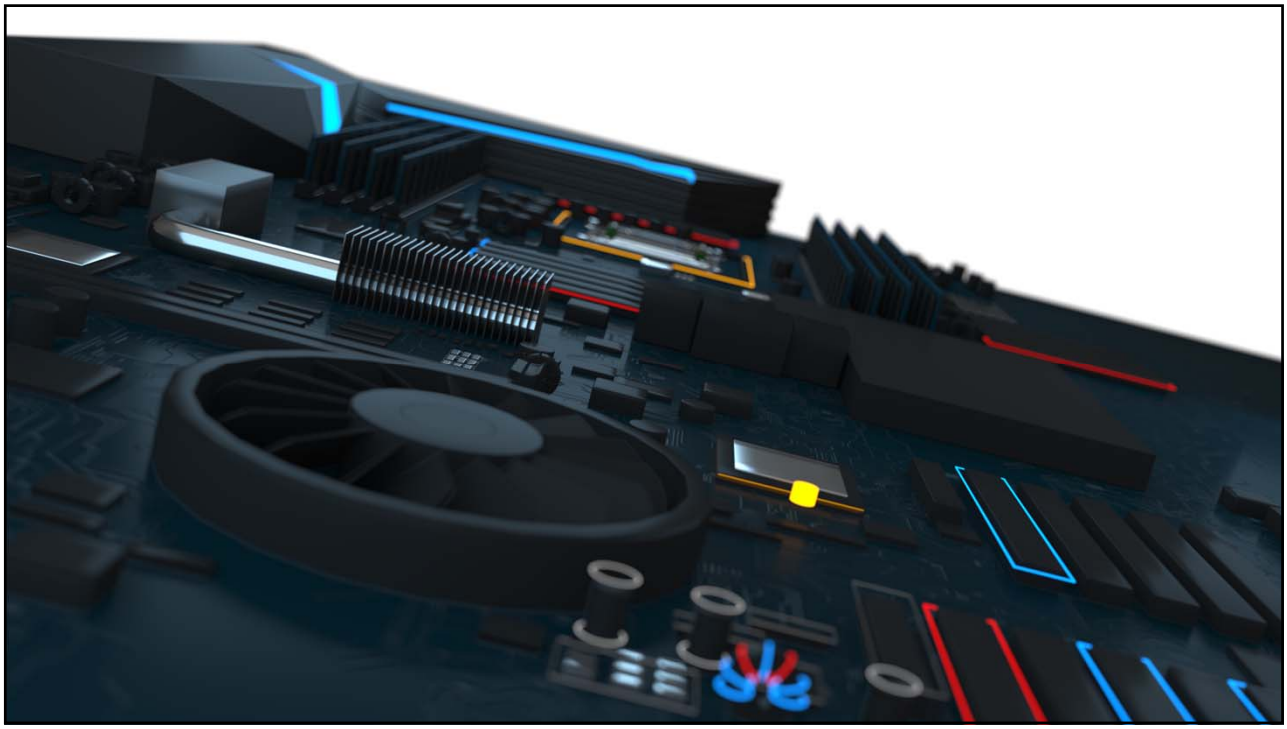

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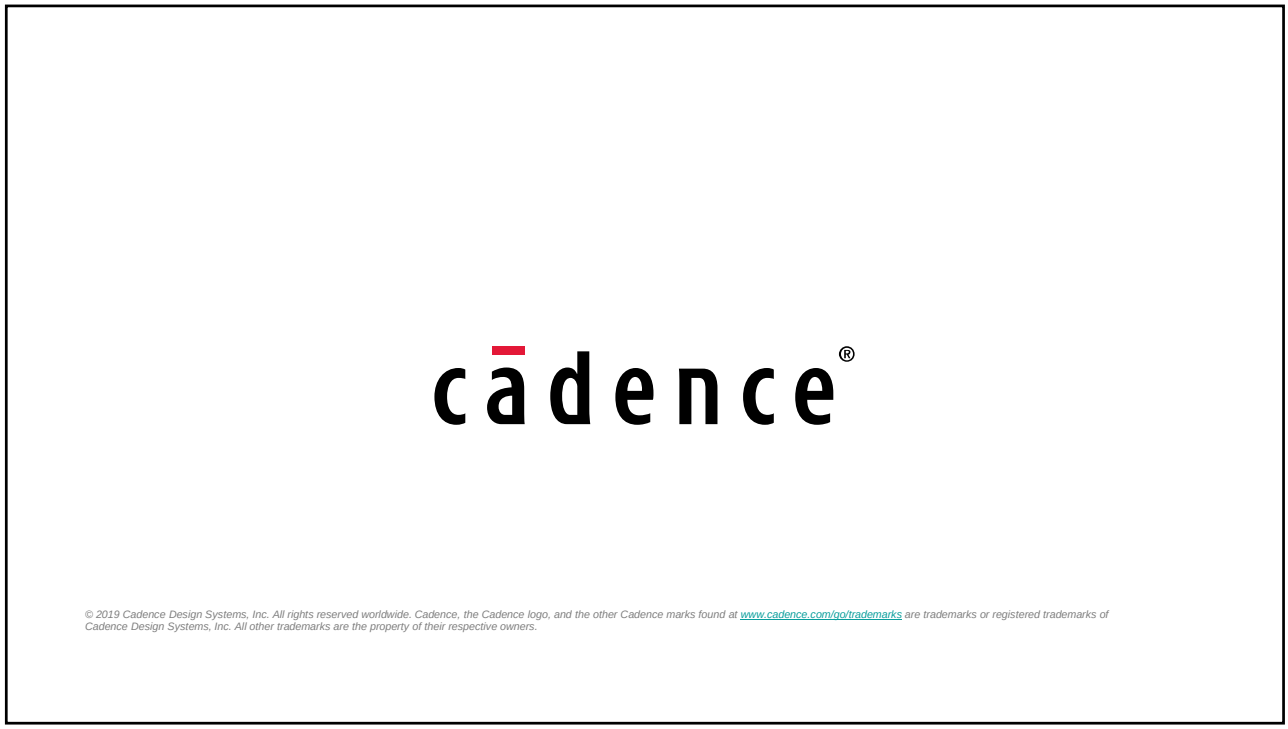

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