熱流商用軟體介紹與應用

Introduction to CFD Commercial Software on Electronics

(I)

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2001/12/28

Course Outline (2001/12/28)

- The Requirement of CFD Software on Electronics
- The Elements of CFD Software
- The Applications
- Introduction to FLOTHERM®

Course Outline (2002/1/4)

- The Virtual vs. the Reality
- The Challenges of Commercial CFD Software
- Q&A

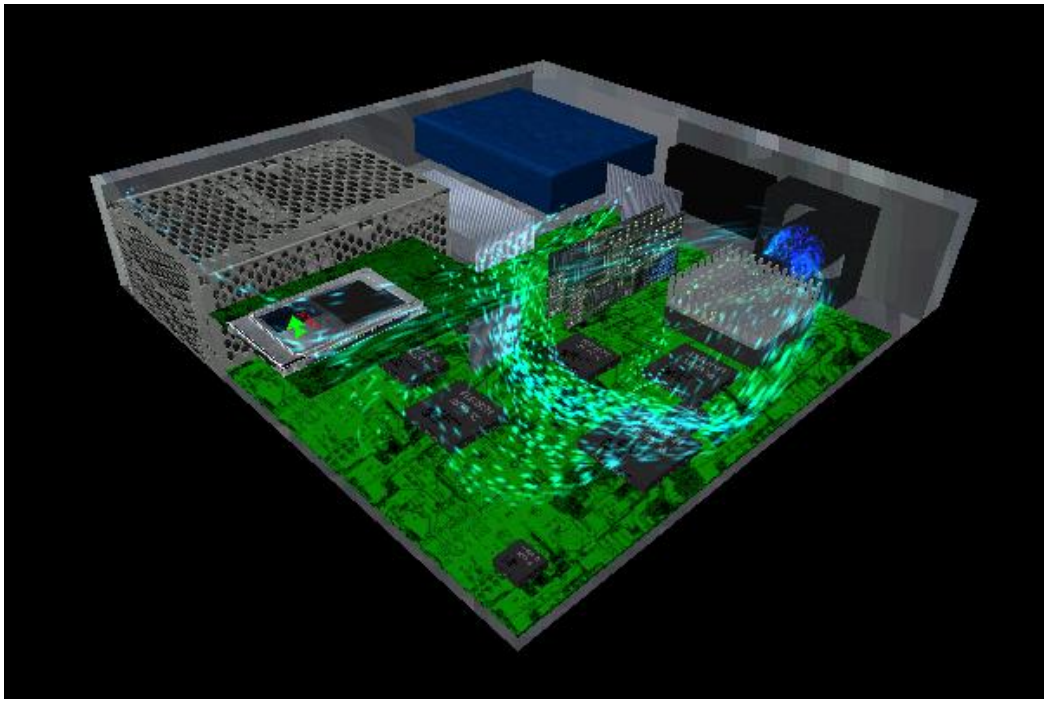
Course Outline (2001/12/28)

- **The Requirement of CFD Software on Electronics**
- The Elements of CFD Software
- The Applications
- Introduction to FLOTHERM®

The Requirement of CFD Software on Electronics

- **Platform**
  Supper Computer
  Unix Workstation
  PC (Windows, Linux)
  Parallel solver (PC cluster)

- **Users Interface (GUI)**
  Pre-processing
    No text editing
    Customization
  Post-processing
    Visualization
    Virtual Reality



The Requirement of CFD Software on Electronics

- **Solver**

  Faster

  More accuracy

  More capabilities

  Specialization

- **Others**

  Reporting

  The interface to CAD and CAE software

  The Relative Database

  ……

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- **The Elements of CFD Software**
- The Applications
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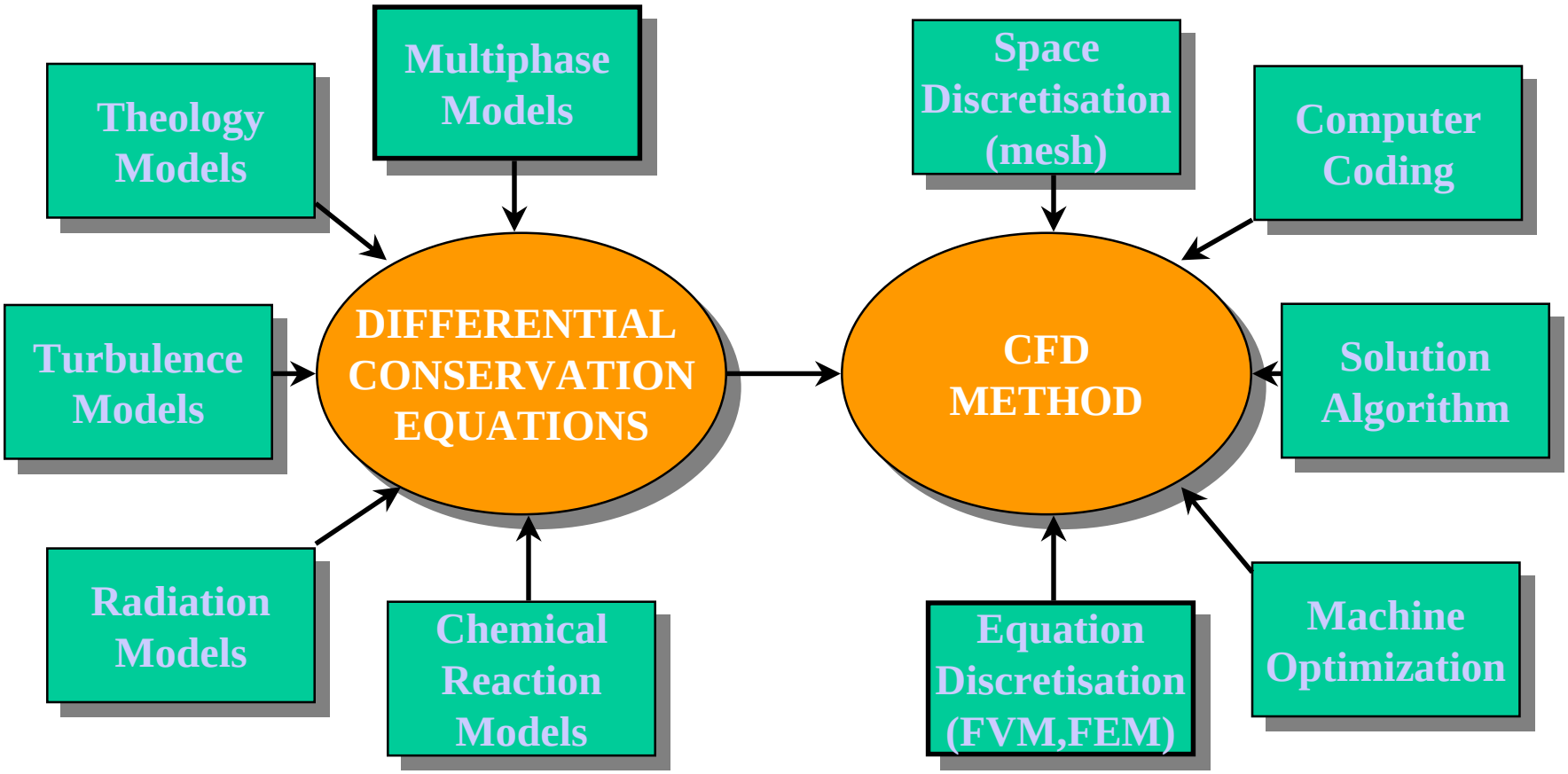
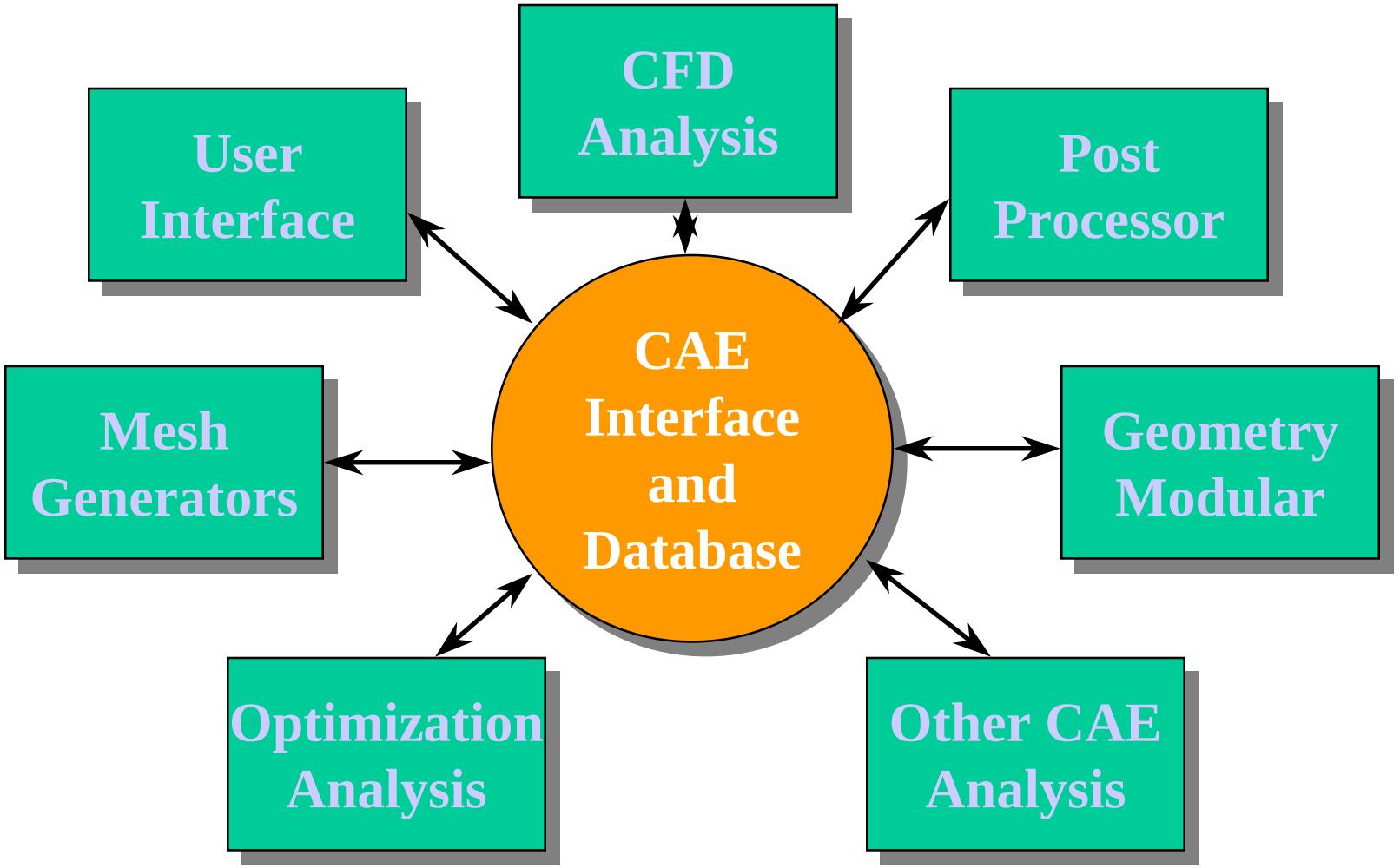
ELEMEMENTS OF CFD



CFD IN CAE



Course Outline (2001/12/28)

- The Requirement of CFD Software on Electronics
- The Elements of CFD Software
- **The Applications**

  Component level

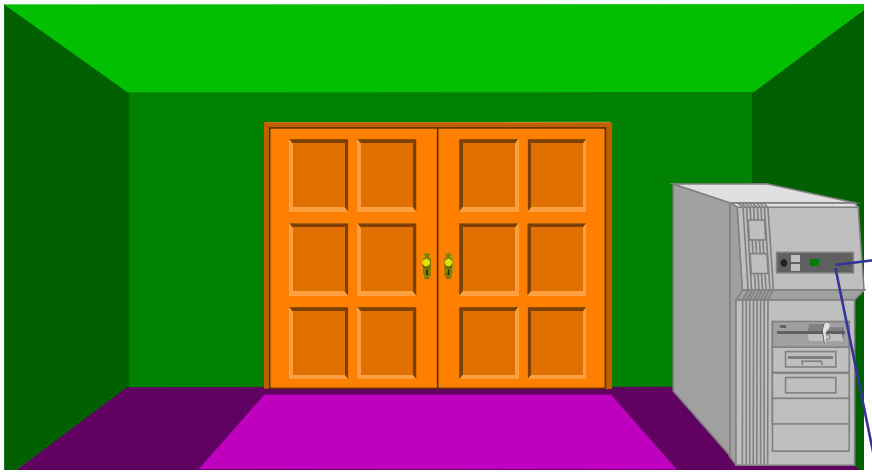
  Board level

  System level

  Environment level

- Introduction to FLOTHERM®

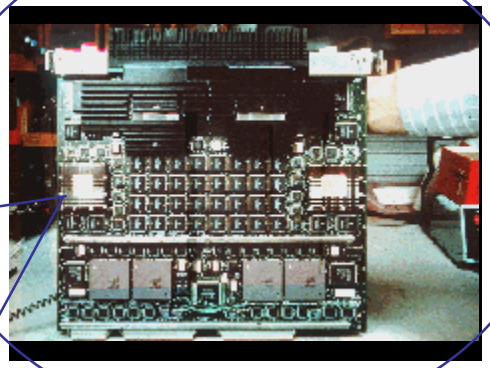
The Applications

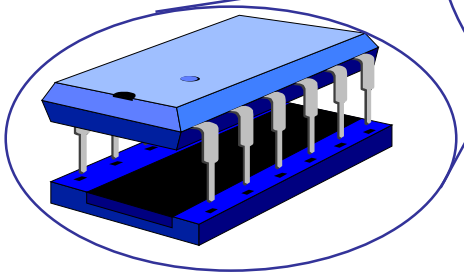


Environment

System

Board





Component

- Standards for exchange of thermal models throughout the supply chain
- Software and support for *design engineers*

Some Examples

q Component Level

Analysis of Heat Fluxes from a PQFP (Flomerics)

q Board Level

Design of a Processor Heatsink (Sequent Computers)

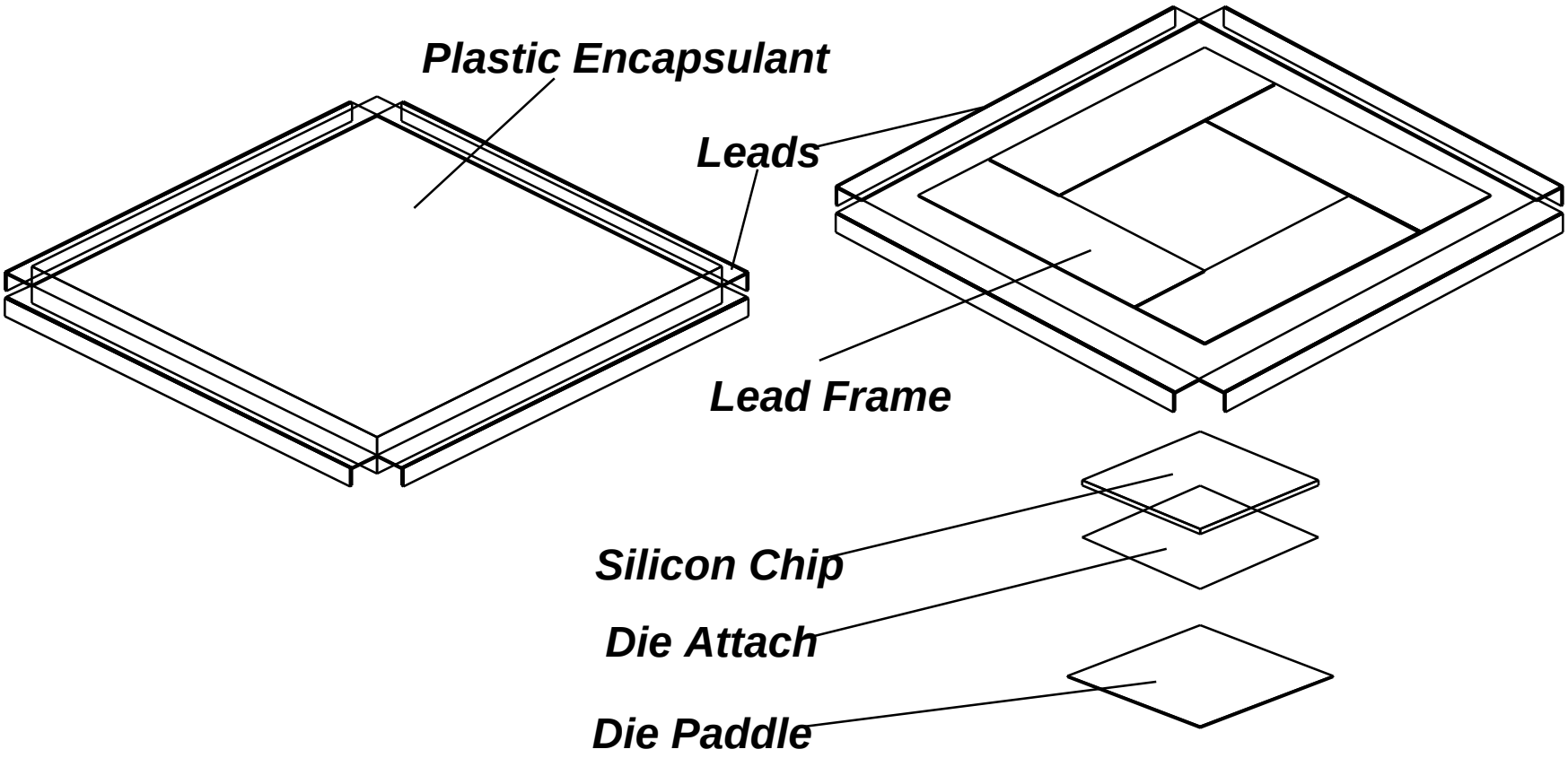
q System Level

Radical Redesign of a PC Enclosure (Intel EUCD)

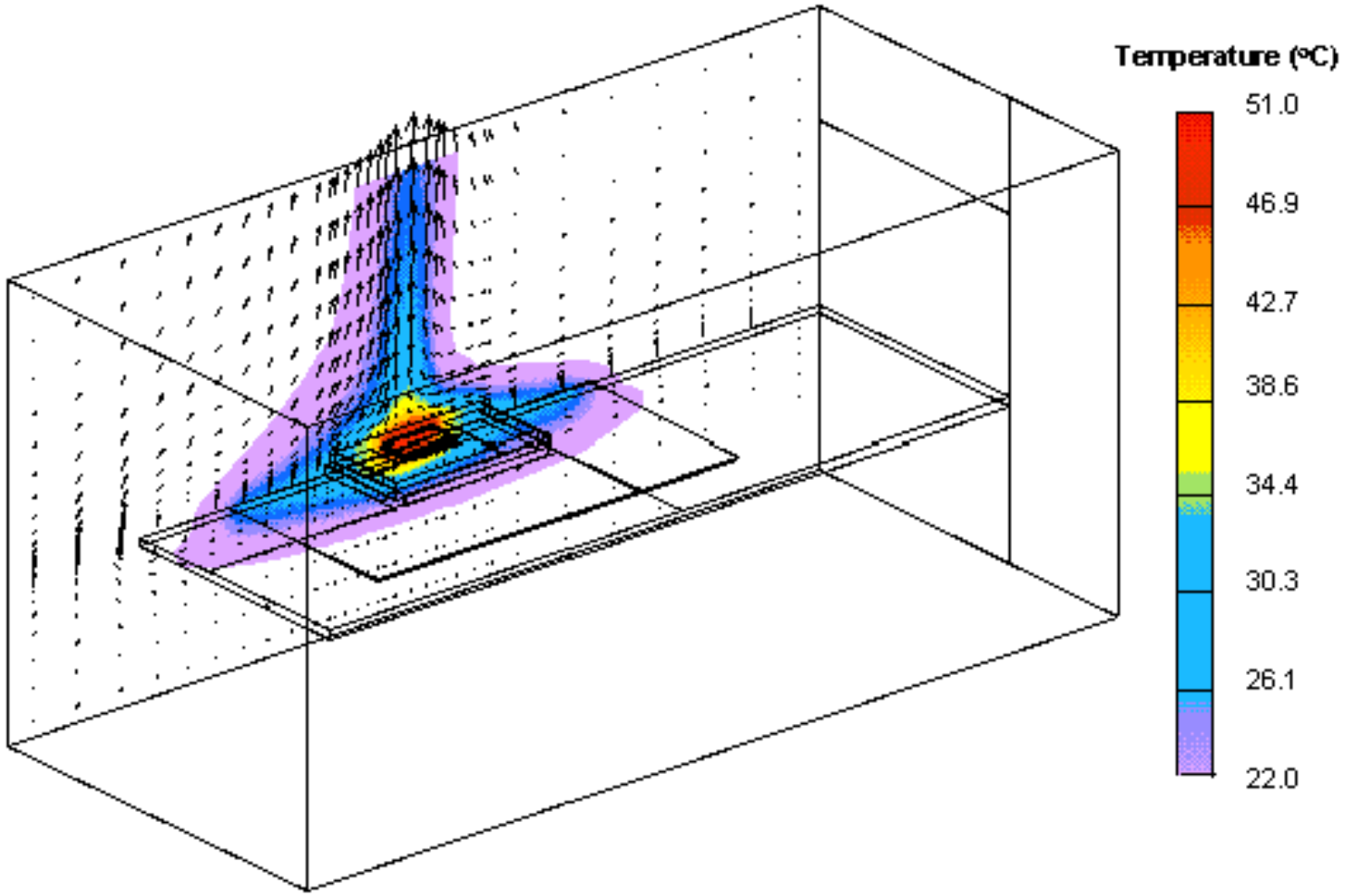
CFD Analysis of 208 Lead PQFP

JEDEC JC15.1 Test Piece
Energy Budget

Model of 208-Lead PQFP - JEDEC Test Case



General View



Results for 208-Lead PQFP

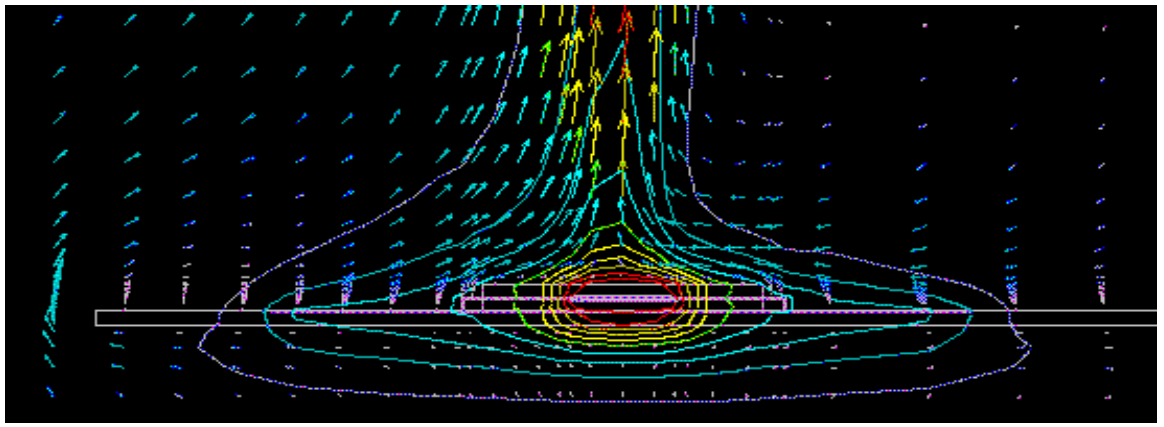
Test conditions:

- Package mounted on JEDEC Low Conductivity test board
- mounted horizontally, in natural convection in small test chamber - ambient 20 ^{o}C

CFD predictions are compared with measured results from 8 JEDEC member companies

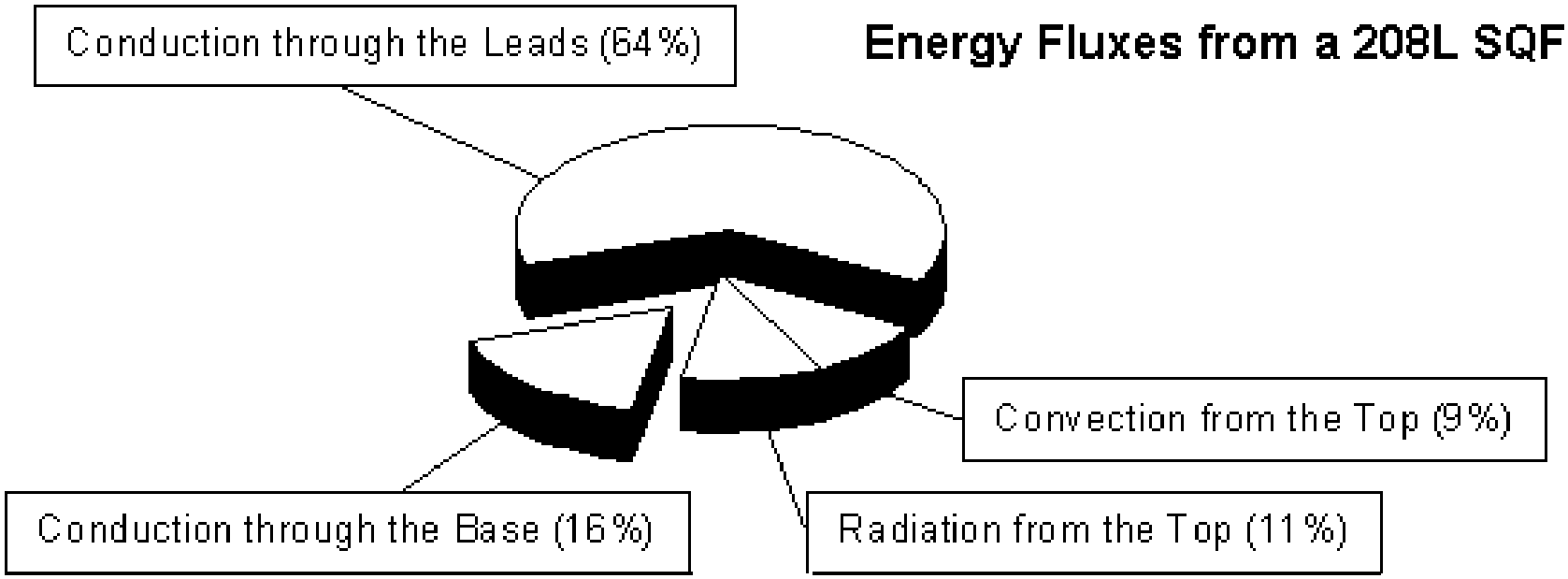
Junction Temperature		R_{ja}	
Measured	Simulation	Measured	Simulation
53 - 56^{o}C	55^{o}C	33 - 36^{o}C/W	35^{o}C/W

Breakdown of Energy Fluxes?



- **Convection from the top**
- **Radiation from the top**
- **Conduction through the base**
- **Conduction through leads**

Energy Flux Budget

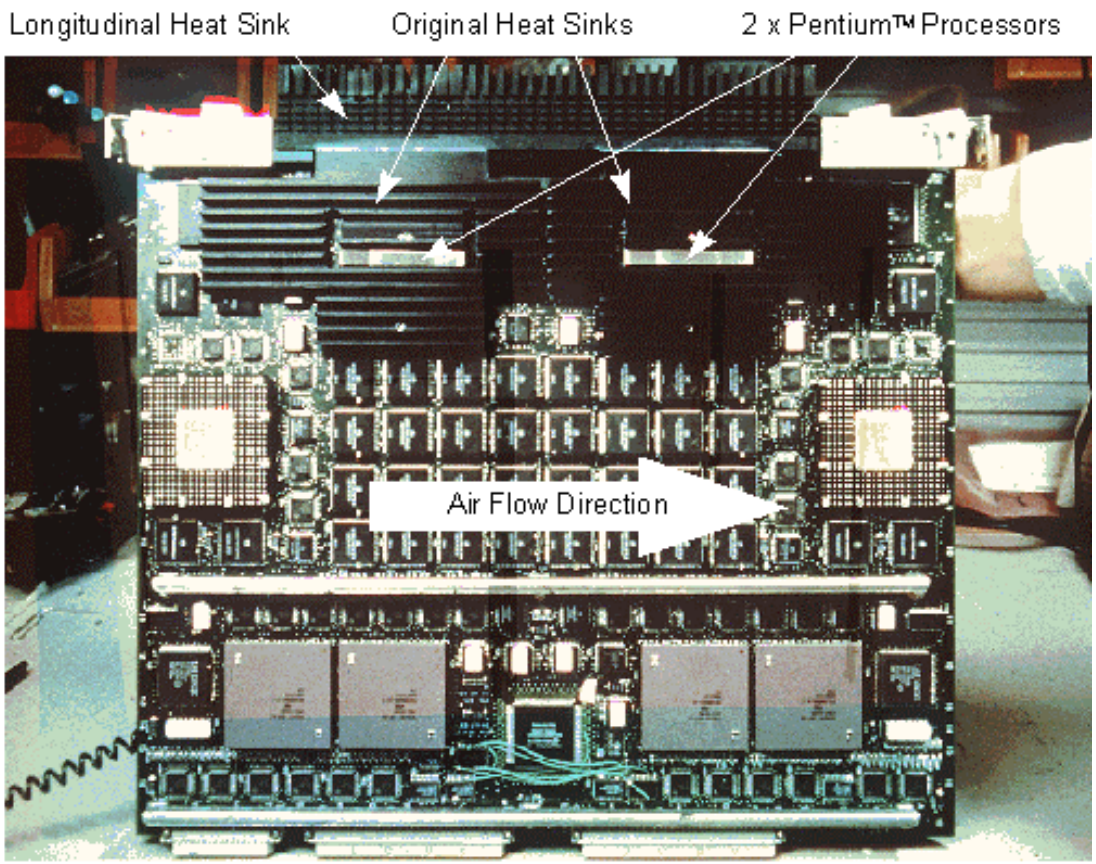


CFD Analysis of a Pentium™ Processor Card

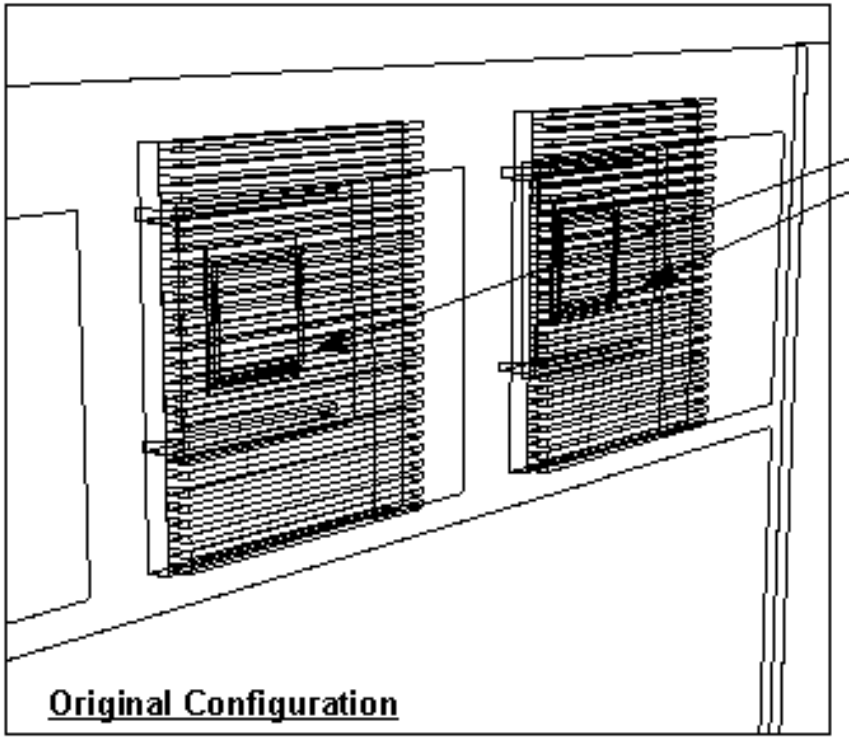
Dual Pentium Processors

Re-Design of the Heatsink

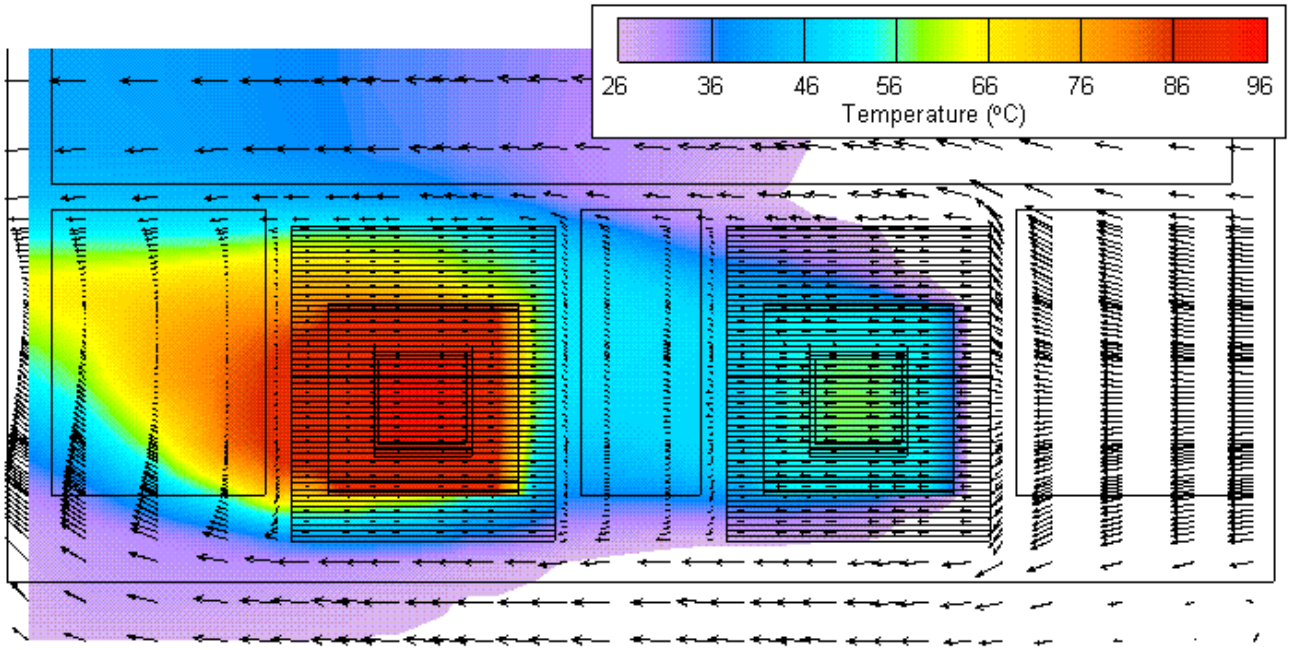
Basic Layout of the Card



Original Design of Processor Heatsinks

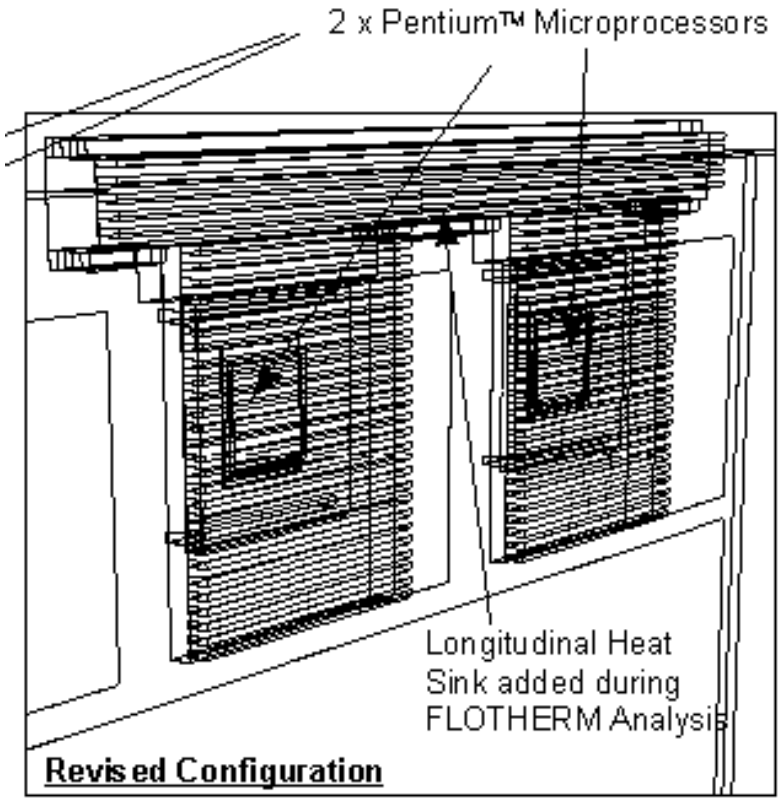


Simulation Results

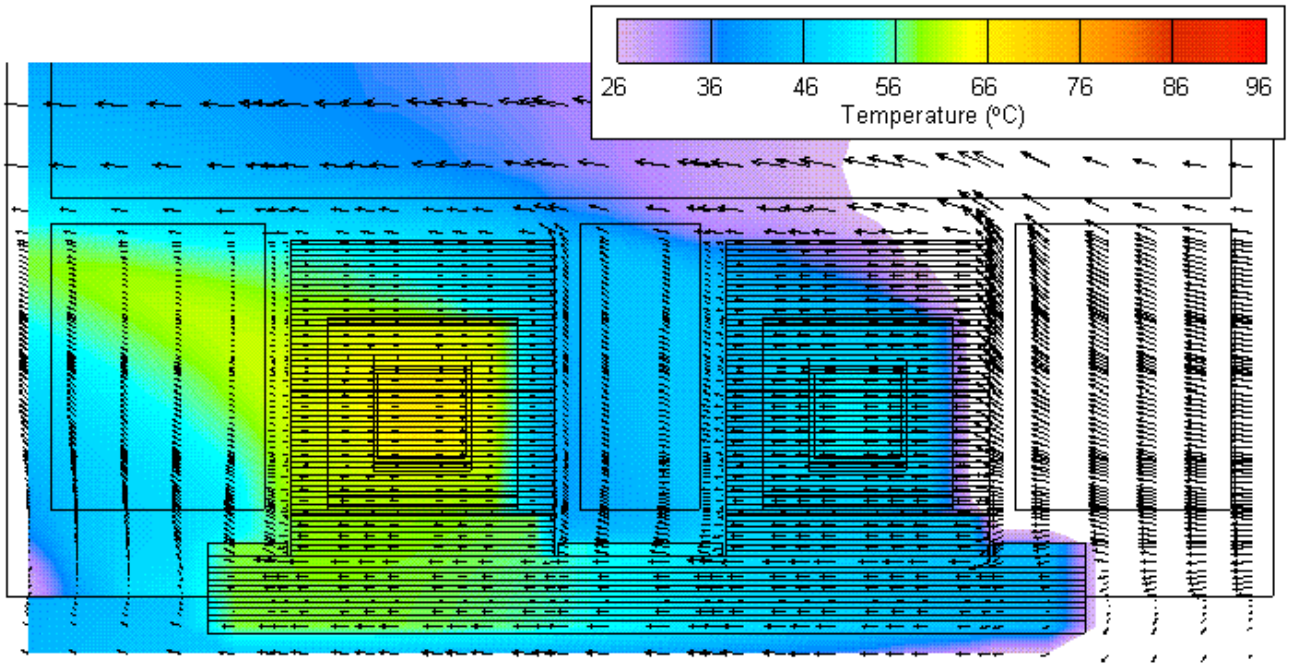


Original Design

Revised Design of Processor Heatsinks



Simulation Results

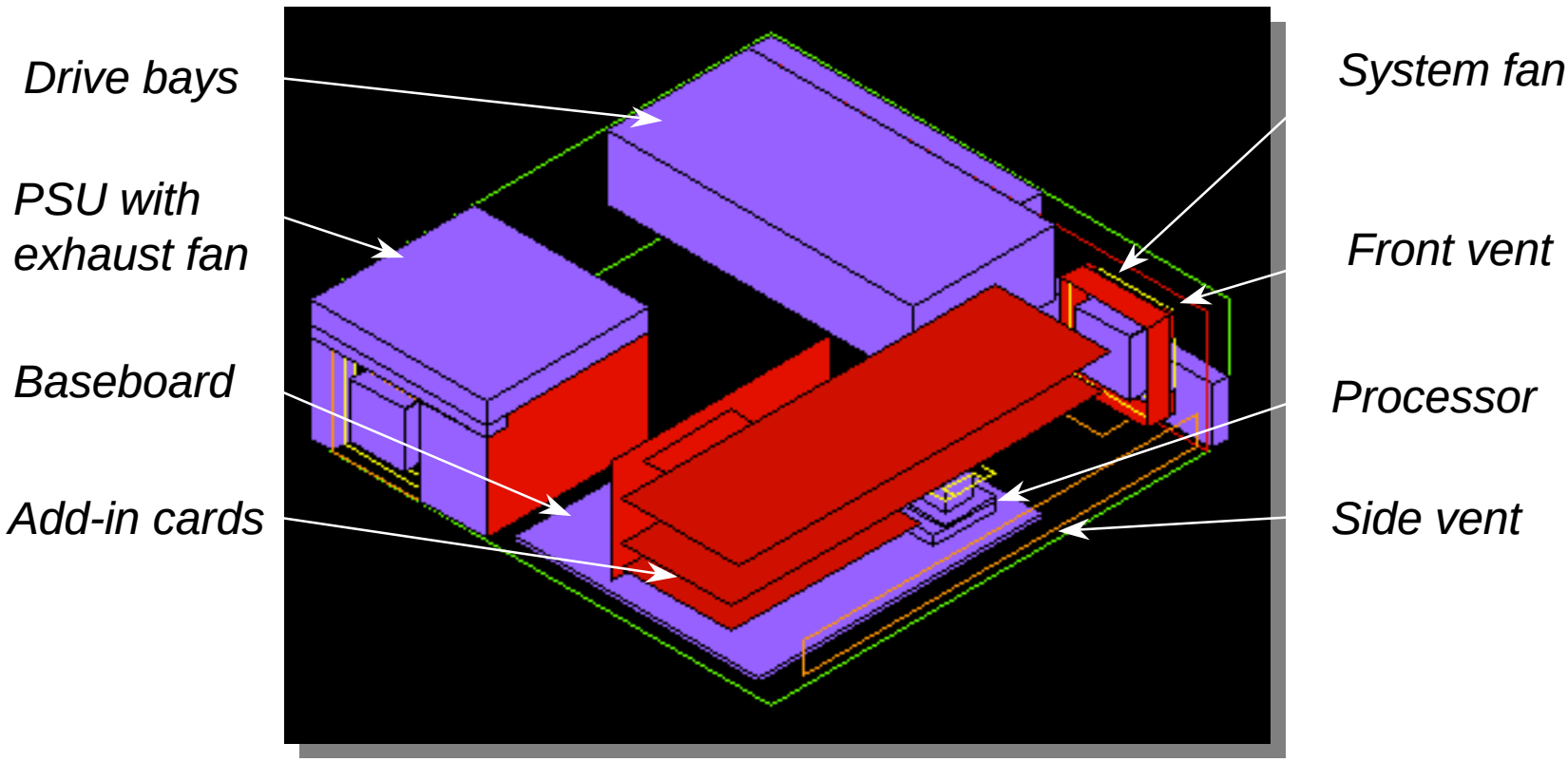


Revised Design

Radical Redesign of a Desktop PC Enclosure

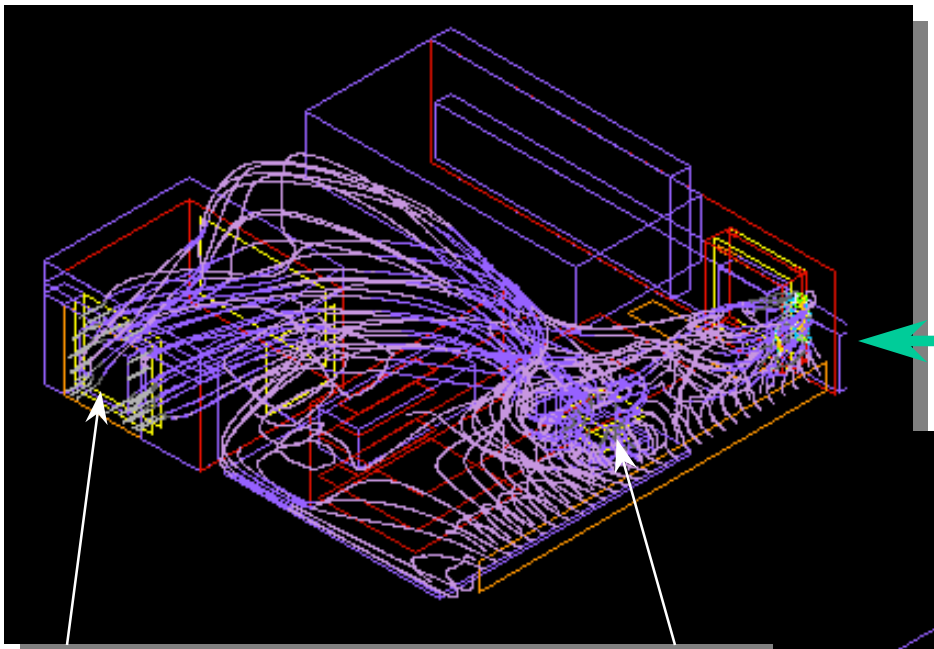
Eliminated the system fan but **still** improved overall thermal performance

Desktop PC Enclosure



Model includes all relevant sources of heat, vents, fans and obstructions.

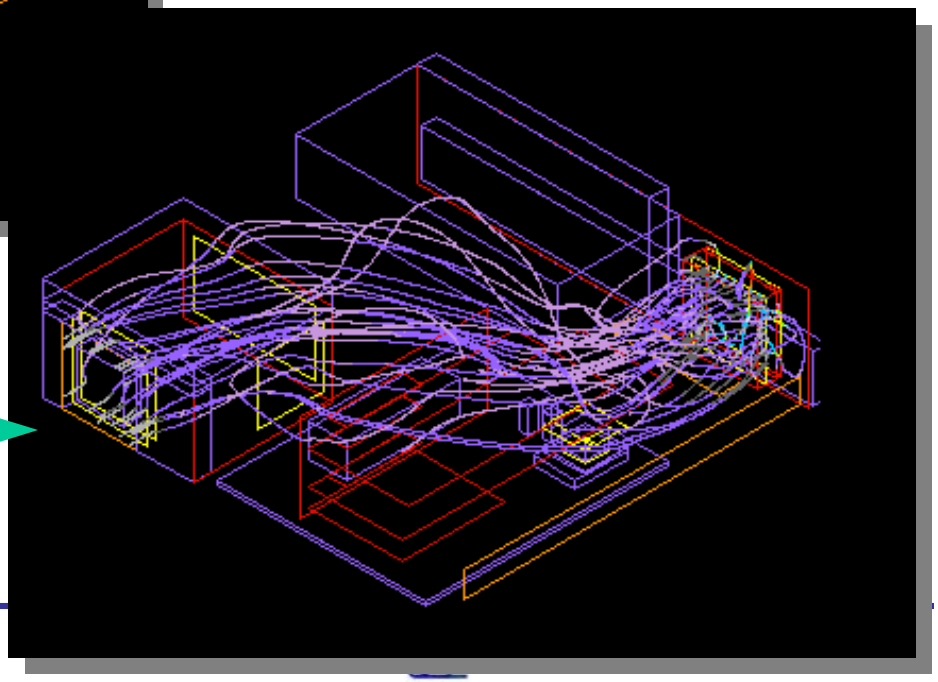
System fan did not blow across processor site...



Most processor cooling air came from side vent

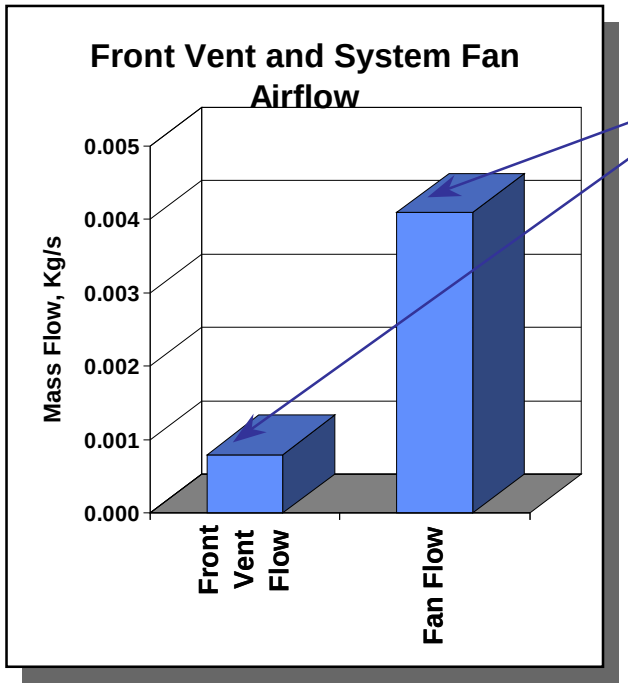
PSU Fan

CPU



Air from second fan went straight out the PSU!

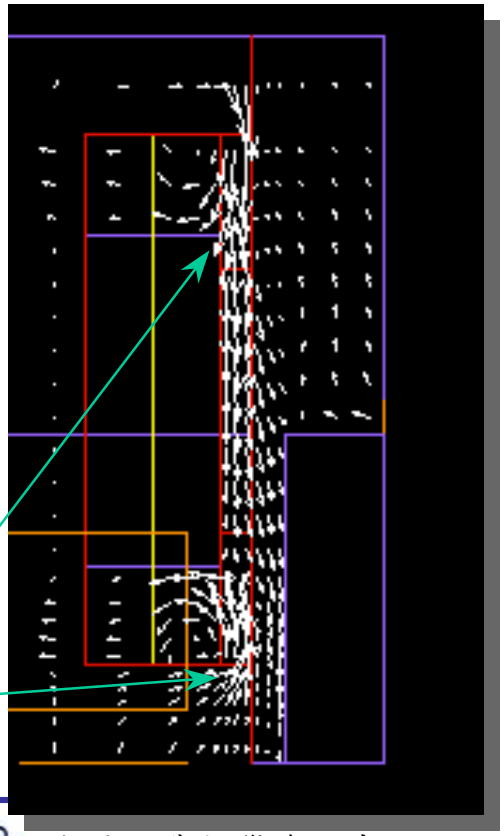
... and recirculated inside air



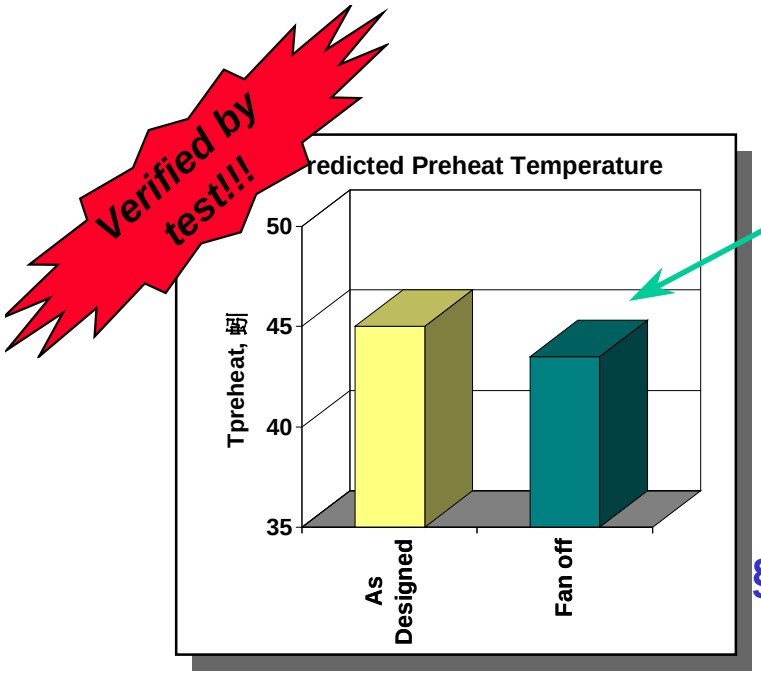
These should be equal!

What was the problem?

- **Inadequate front vents**
- **Fan mount design promoted recirculation**



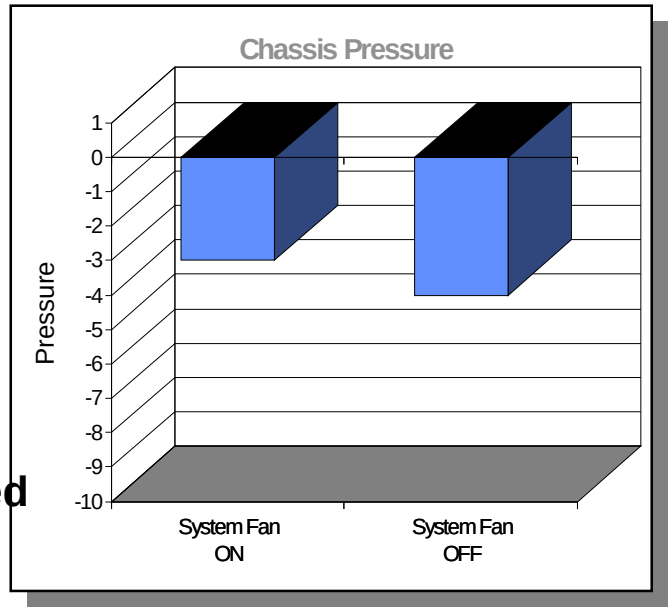
In fact, the fan made the processor run WARMER!



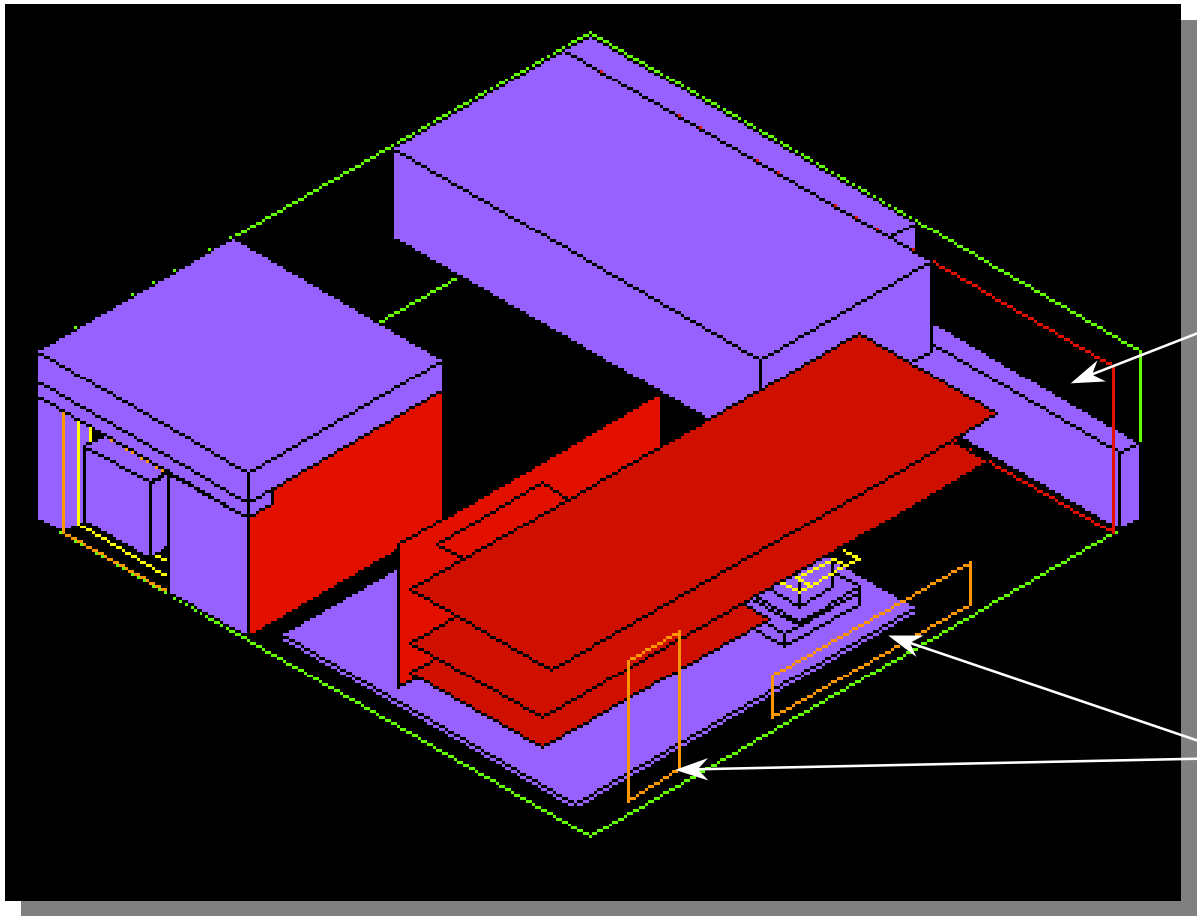
Processor temperature DROPPED about 1.5℃ when fan was SHUT OFF!

WHY?!?

- **Side vent cools the processor**
- **System fan off = lower chassis pressure**
  - **More air sucked through side vent**



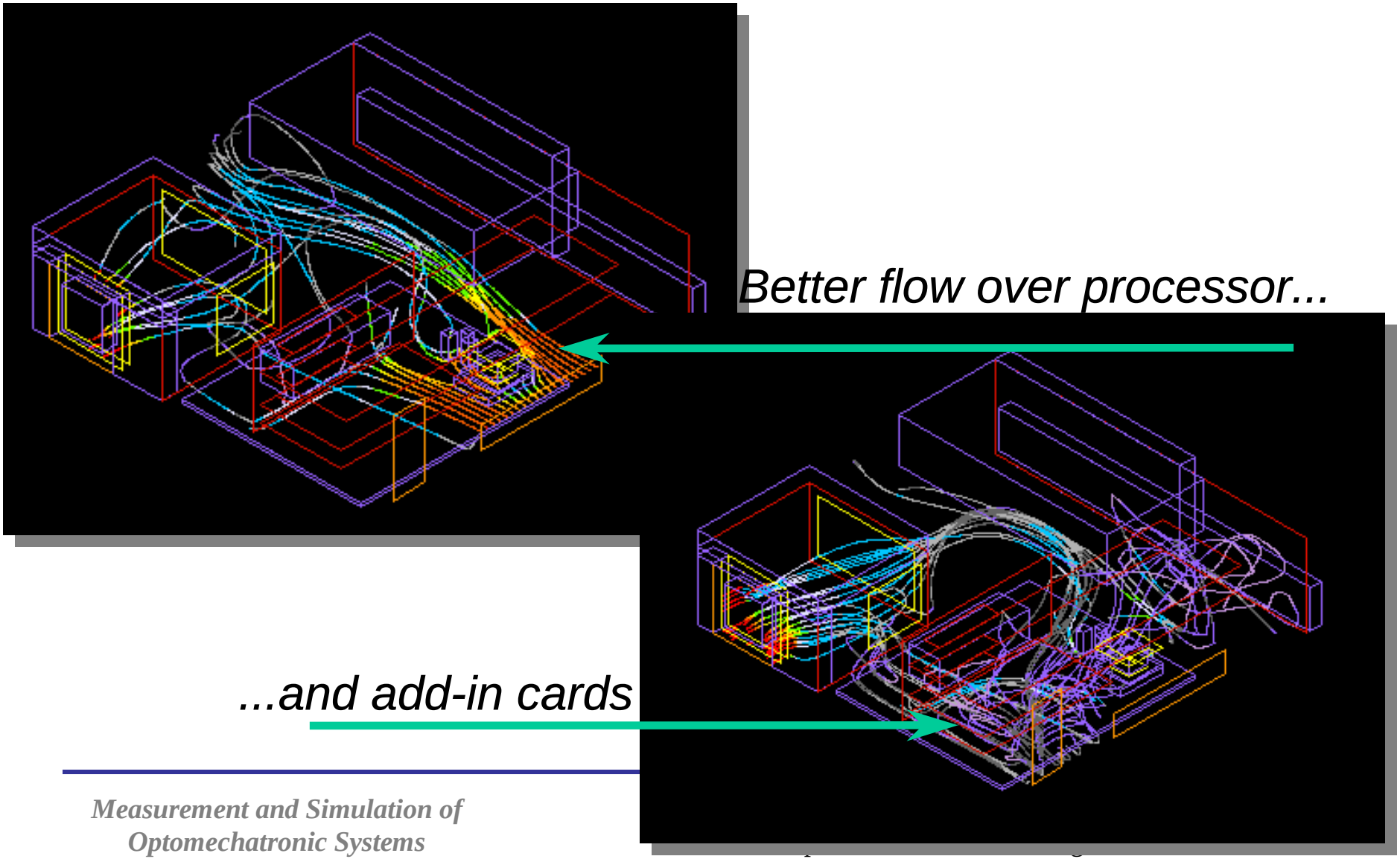
So, here's what was done to to fix this chassis...



System fan ELIMINATED and openings removed

Side vents optimized for processor location and add-in card cooling

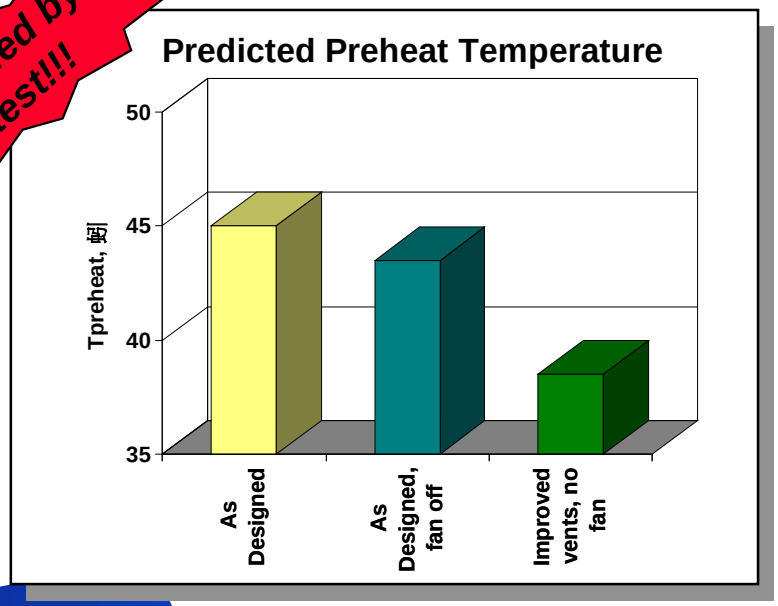
... and we got better flow and cooler temperatures



Eliminating fan and reducing vents improved this system's performance!

- System fan was counter-productive!
- Cooling performance improved by REDUCING venting

Verified by test!!!



Saved cost of second fan
Improved cooling
Reduced acoustic noise

Conclusion

- Hundreds of documented success stories
- Shown to reduce the cost and effort in the thermal design process

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