

LCR

EMBEDDED
SYSTEMS, INC.®

Chassis • Backplanes • Integrated Systems

Helping Our Customers Achieve Their Mission



Feeling the *Heat*

*Solving Thermal Challenges in the
“COTS, but” World*

www.lcrembeddedsystems.com

VPX: A Chassis Manufacturer's Perspective

LCR Embedded Systems:

Embedded systems design
and manufacturer
specializing in ***standards-
based custom designs*** for
the Mil-Aero market



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What is “COTS, but”?

- Standards-based custom designs = “**COTS, but**”
 - Customer want the reliability, scheduling, and cost benefits of COTS, but
 - They also want a system tailored to their exact, unique needs.



VPX Market: Strong and Growing

VPX is proving to be the current choice for many new defense programs.

The vast majority of new designs are in the 3U VITA 48.2 form factor.



Challenges ... ?

- What specific challenges does a chassis designer/manufacturer face when implementing VPX?
- Described I/O-related challenges last year
- This year – ***thermal!***

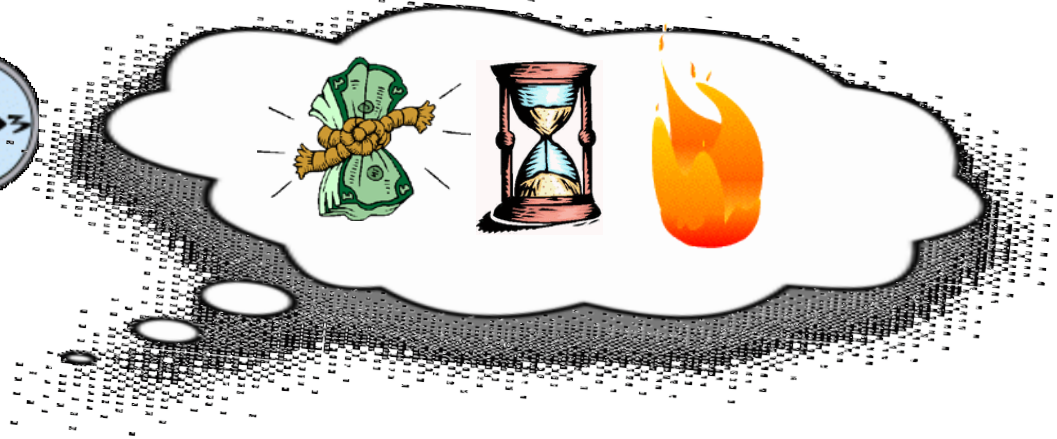


VPX: Thermal Challenges

- Mil-Aero requirements continue to:
 - Add processing power,
 - Add heat,
 - Shrink package sizes, and
 - Enter harsher environments.



How does a designer solve the ever-increasing thermal challenges of COTS, but?



Some Factors to Consider

Requirements Inflation

Simulations & Analysis

Prototyping



Some Factors to Consider

Requirements Inflation →

Simulations & Analysis

Prototyping

Is the system really going to:

- Need as much cooling as requested?
- Be used in the requested environments?



Some Factors to Consider

Requirements Inflation

Simulations & Analysis →

Prototyping

Can help with:

- Risk reduction
- Optimization

Exercise caution without having validated on similar systems!



Some Factors to Consider

Requirements Inflation

Simulations & Analysis

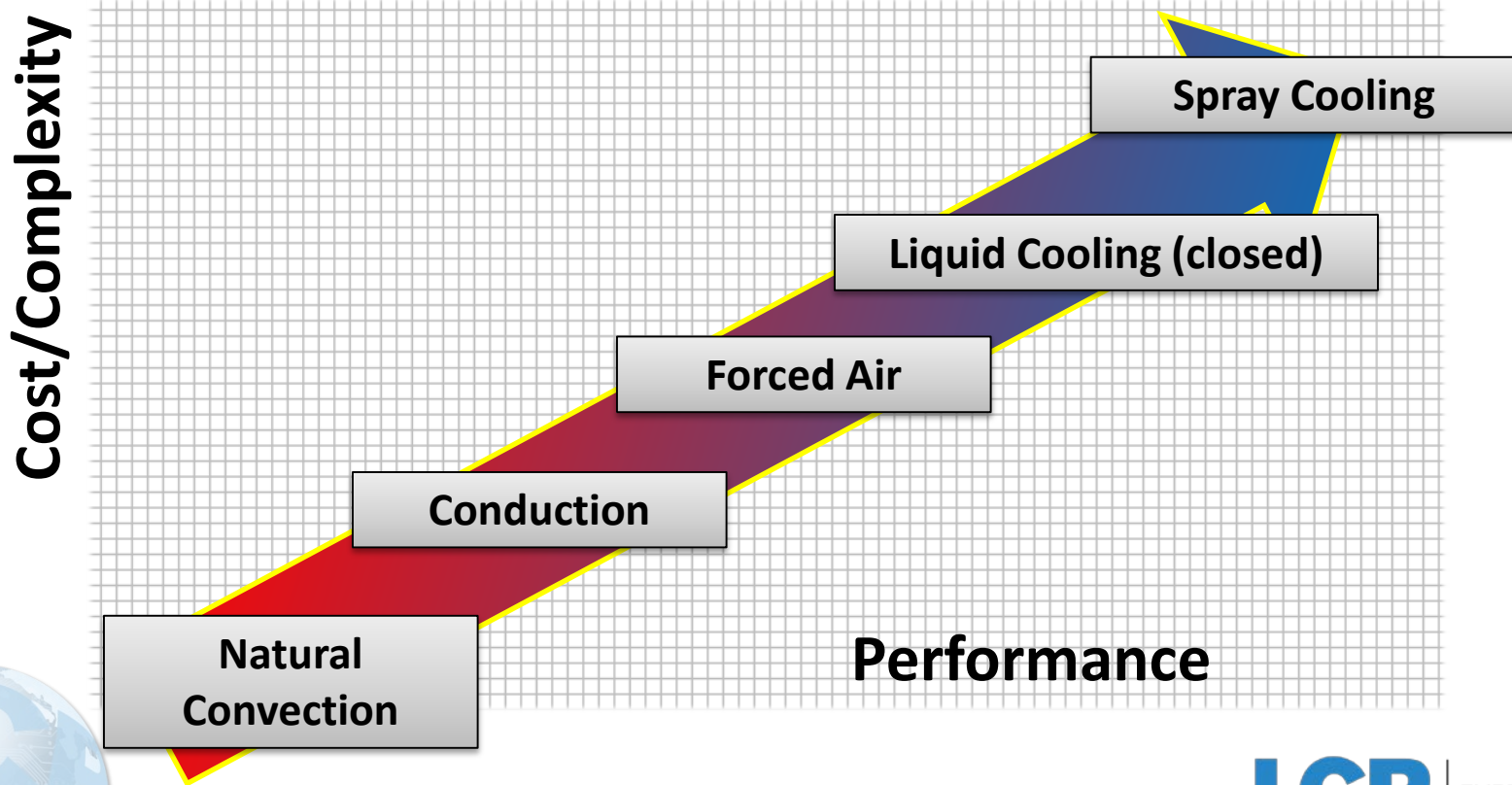
Prototyping



Provides further risk reduction, but today's schedules and budgets don't always allow it.



What Are The Options?



Narrowing Down The Options

Cost & Performance always matter, but also

Payload

Weight

Environment

Infrastructure

Life

Complexity



Cooling Options Overview

1. Natural Convection
2. Conduction
3. Forced Air
4. Liquid
5. Spray
6. Hybrid Methods



Cooling Options: Natural Convection

- + Inexpensive
- + Quick
- + Low Risk
- + No support infrastructure
- + Rugged

- Worst Performance



Cooling Options: Conduction

- + Inexpensive
- + Quick
- + Low Risk
- + Rugged

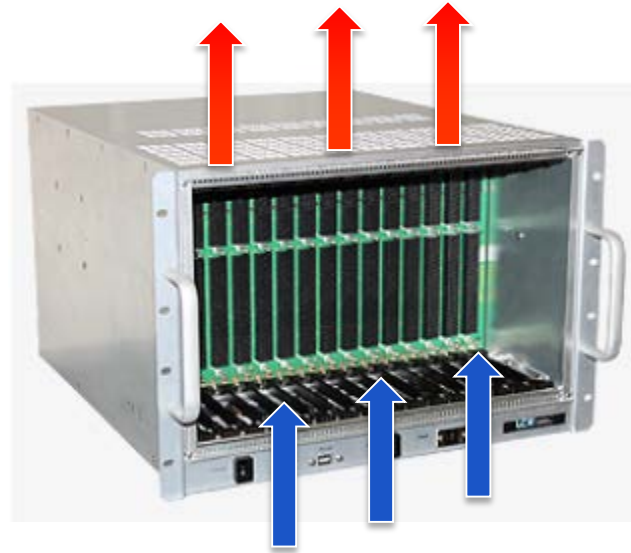
~ Minor support infrastructure
- Somewhere to conduct heat



- Mediocre Performance

Cooling Options: Forced Air

- + Inexpensive
 - + Quick
 - + Low Risk
 - + Decent Performance
- ~ Minor support infrastructure
- Source of cool air



- Needs controlled environment

Cooling Options: Liquid

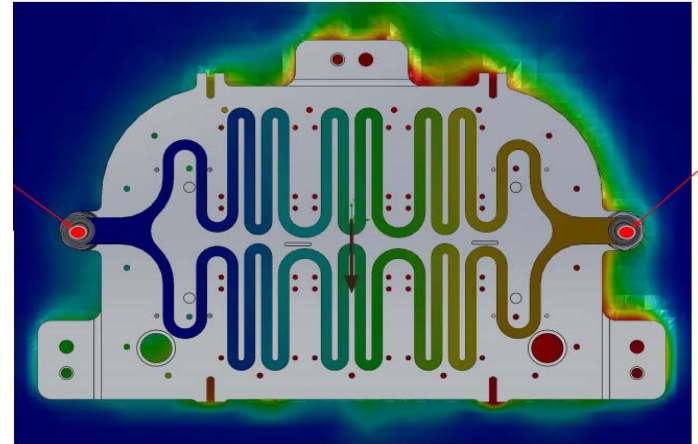
+ High Performance

~ Longer Development

~ Medium Risk

- Major support infrastructure

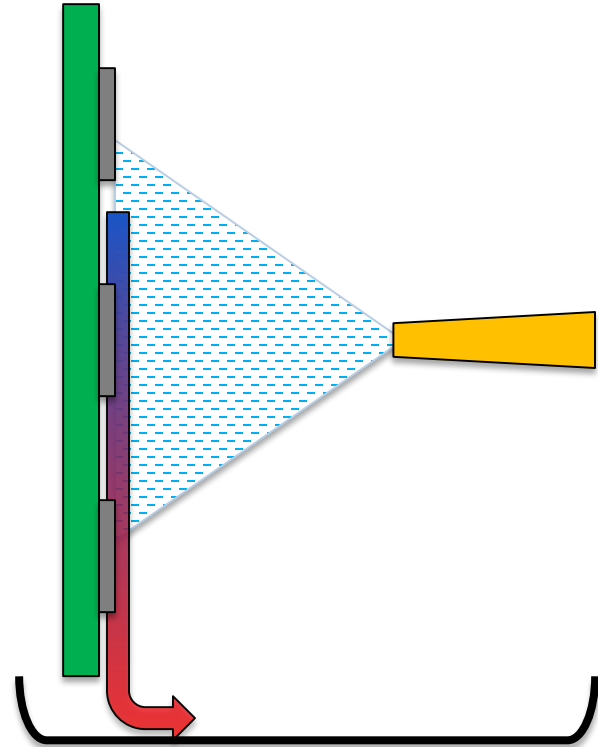
- Expensive



Cooling Options: Spray

+ High Performance

- Long Development**
- High Risk**
- Major support infrastructure**
- Expensive**



Cooling Options for “COTS, but”

- The standard techniques will work for a COTS chassis, but ***COTS, but*** requires a little more creativity.

Hybrid methods!
Bending the Rules!

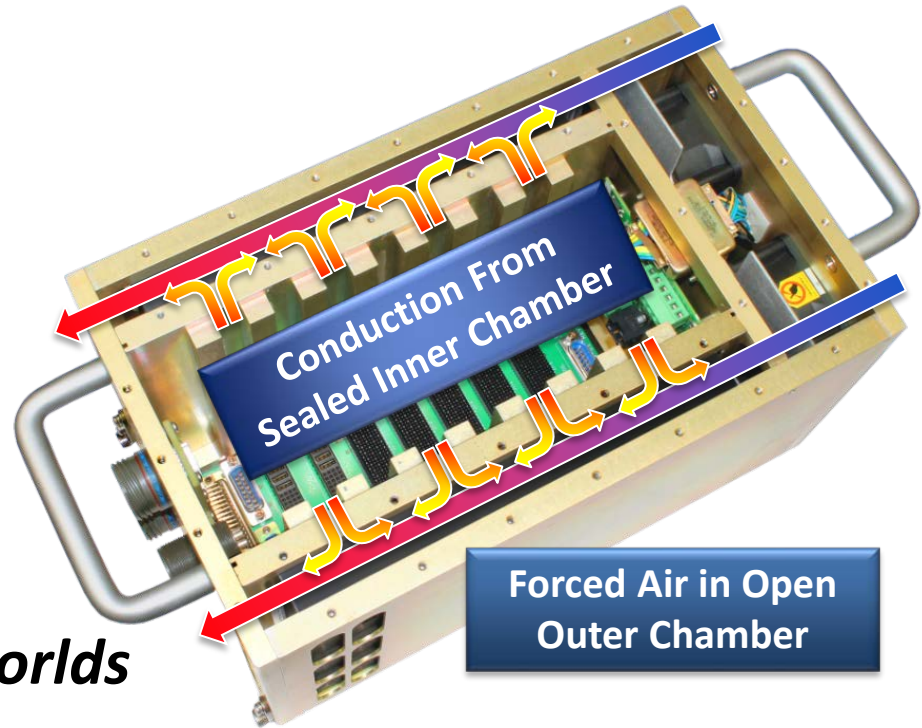


Hybrid Methods: Forced Air/Conduction

+ Higher Performance of
Forced Air

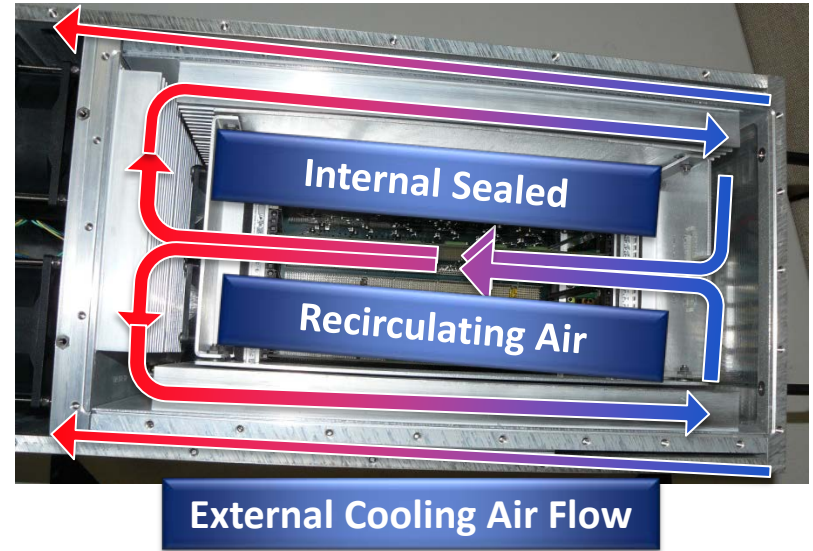
+ Rugged Levels of
Conduction

Combining the best of both worlds



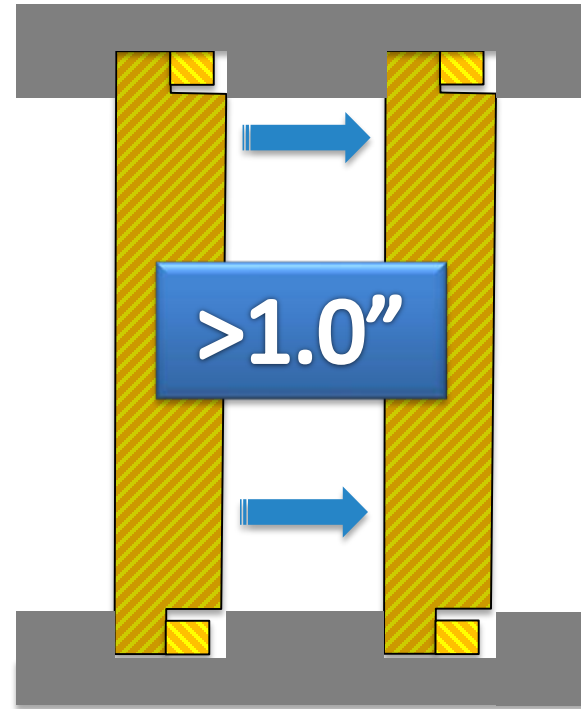
Hybrid Methods: Forced Air/Forced Air

+ Can use air-cooled COTs boards in a more rugged application



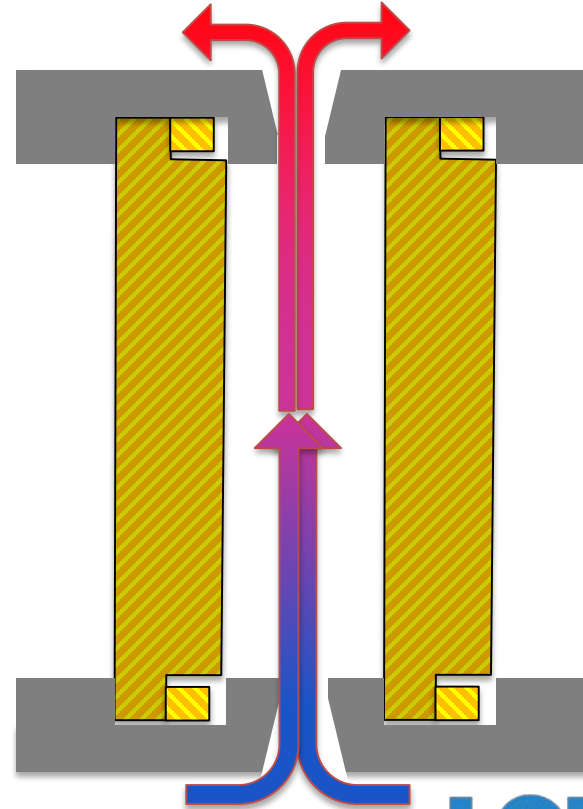
Bending the Rules: Board Pitch

+ Reduced Thermal Density



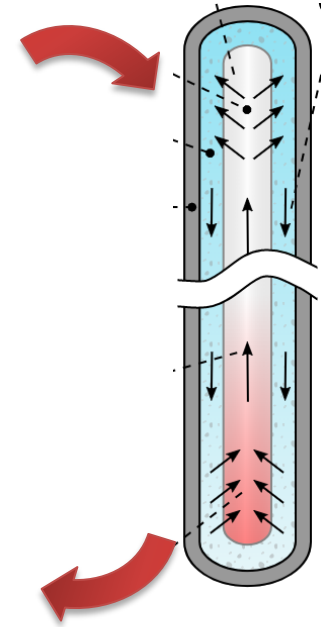
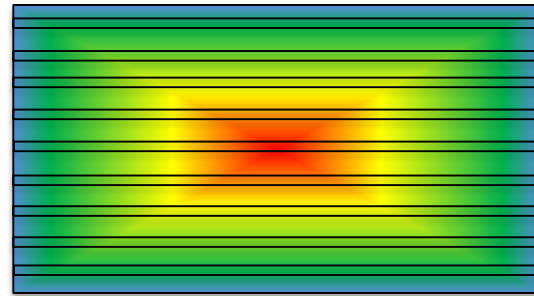
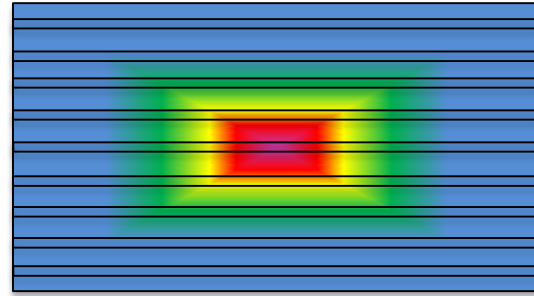
Bending the Rules: Board Pitch

- + Reduced Thermal Density
- + Improved Air Flow by Adding Forced Air



New Innovations: Heat Pipes

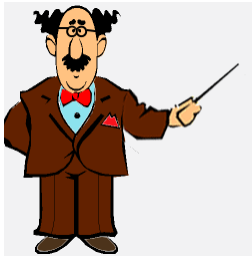
Can be combined with any method to improve overall effectiveness.



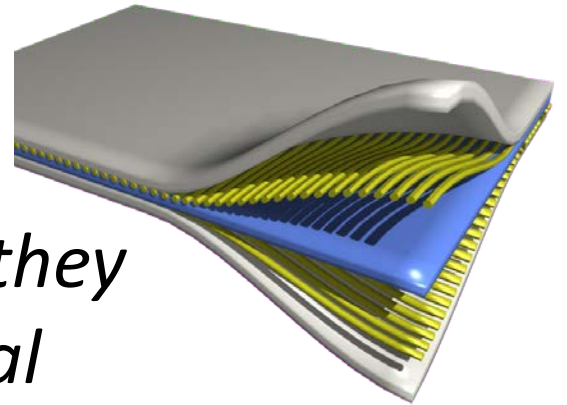
New Innovations: Alternate Materials



Composites?! What?! They're a thermal insulator!



*When designed correctly, they can provide **400+%** thermal conductivity vs. aluminum with major weight savings.*



Feeling the Heat?

With careful planning, a flexible outlook, and a little innovation ...

The **COTS, but** thermal challenges can be solved!



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Questions?



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