PERFORMANCE TECHNOLOGIES

Cool Strategies

For Maximizing Airflow to MicroTCA® Systems

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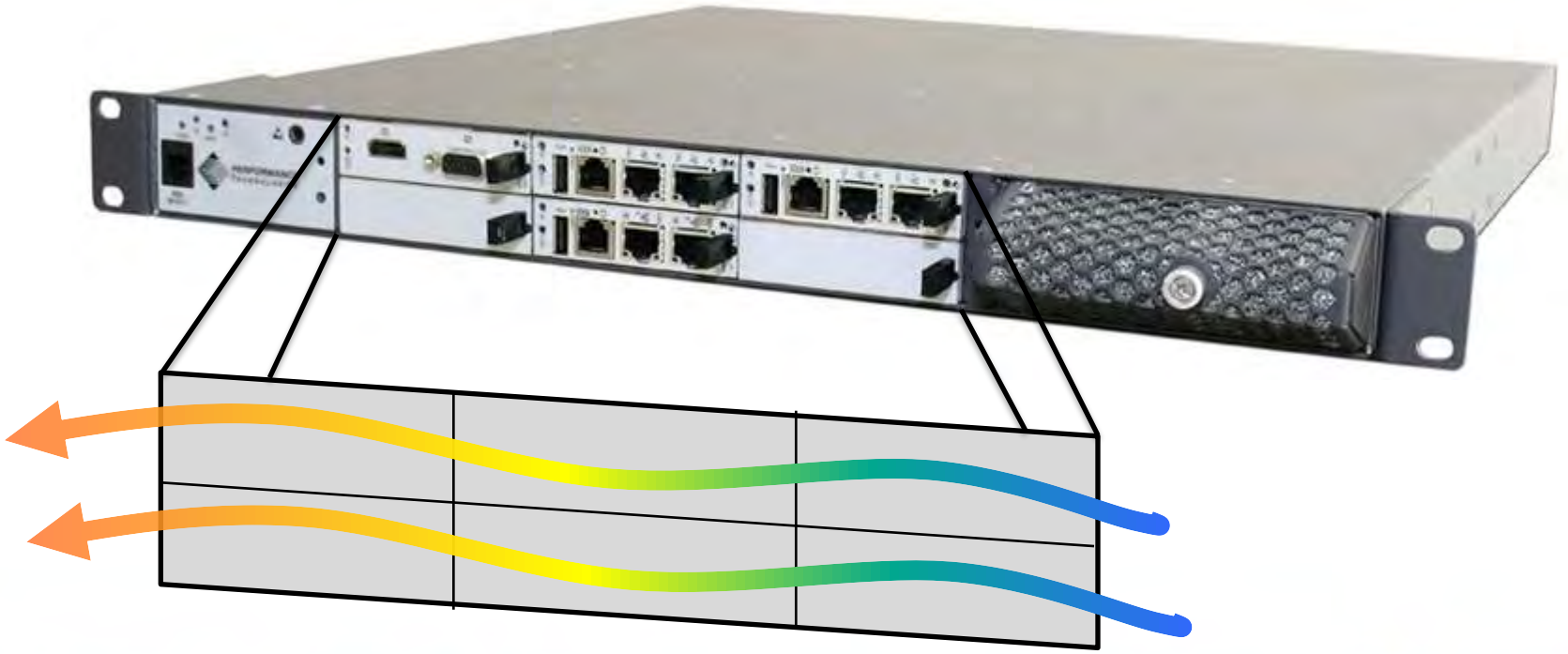
Agenda

- Cool Strategies for Maximizing Airflow in MicroTCA® Systems
  - Second Generation MicroTCA platforms:
    - Dramatic reduction in costs
    - Superior compact design vs traditional large platform
    - MCH functions built-in, and in back of the chassis
    - Cooling becomes more effective and efficient
    - Front-to-back airflow meets NEBs requirements vs Side-to-Side
  - MicroTCA Architectural Strategy
  - Platform Management Control & Cooling Policies
  - Embedded x86 processors strategies

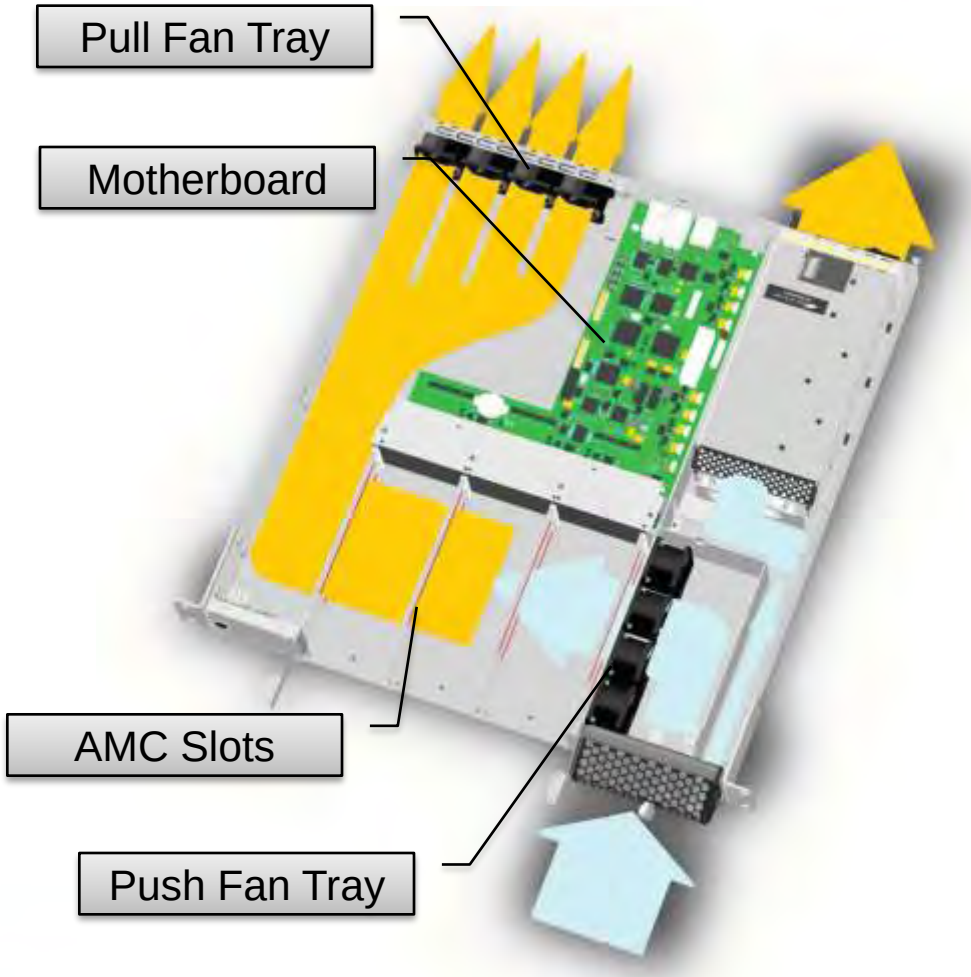
Second Generation MTCA® Architectural Strategy

- 1U, 6-slot Platform
- High Density, High Integration, Cost-Effective
- Front-to-Back Airflow



MTCA® Architectural Strategy

- MCH functions are integrated into the rear-mounted motherboard
- Minimizes airflow impedance to AMC slots
- Allows for front-to-back airflow with push/pull fans

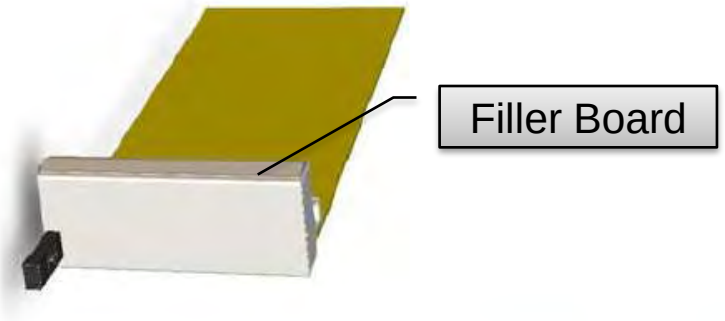


Chimney Effect

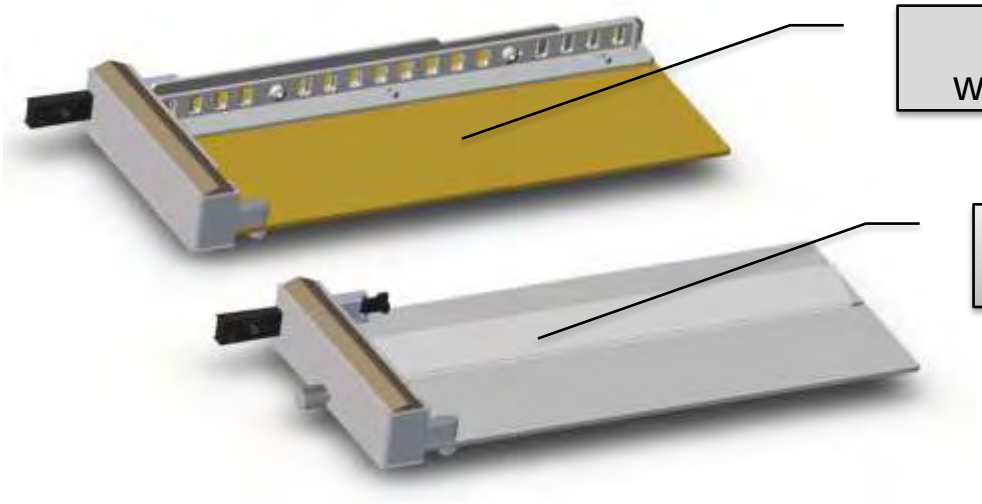
- Tested to maximum power tolerances
  - Six modules @ 40Wmax per mid-single AMC
  - 55C ambient (operating temp)
  - The cooling system supports a delta temperature rise less than or equal to 15°C at an ambient of 55°C for 96 hours.

AMC Placement Strategies

- Place high-power/high-performance boards at the beginning (coolest part) of the air-path
- Thermal loads should be spread evenly throughout the system
- Unused slots need filler boards

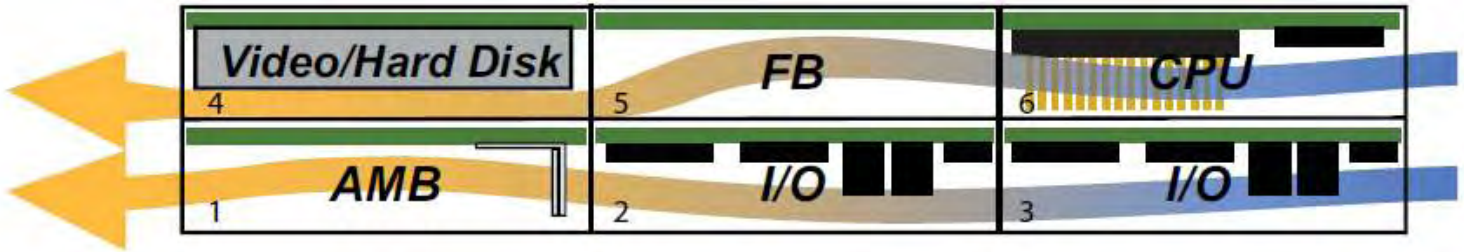


Air Management Blades



Air Management Blade
w/internally adjustable baffle

Air Management Blade
w/externally adjustable baffle



Air Management Blades help to balance airflow impedance throughout the platform

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Platform Management

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Platform Management

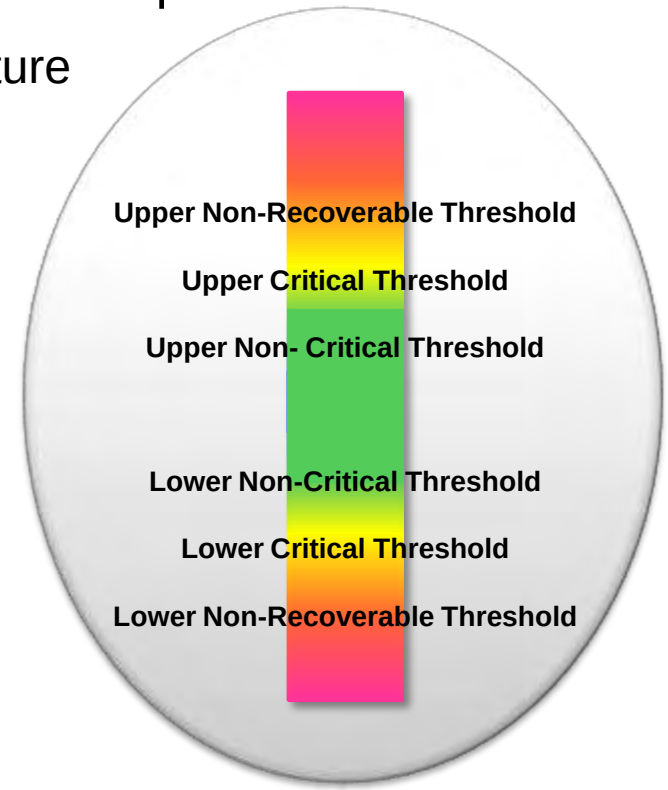
- Platform Management = Shelf Management
- Intelligent Platform Management Interface (IPMI) is:
  - Standardized, abstracted interface to monitor system health and manage the system
  - PICMG Adopted IPMI originally for CompactPCI® 2.9 in 2000
  - Combination of Microcontroller, Firmware, and Sensor IO
- Monitors, Manages, and Controls the Field Replaceable Units (FRUs) in a Shelf
- FRUs include:
  - Payload Boards
  - Power Supplies
  - Fans
  - Infrastructure Modules

Managing

- Manages each Field Replaceable Unit (FRU)
  - Asset Information:
    - FRU Manufacturer
    - FRU Product Name & Model Number
    - FRU Serial Number
    - FRU Geographical Address
    - FRU Version

Monitoring

- Analog Threshold Examples
  - Board temperature
  - Processor temperature
  - Voltages
  - Fan Speed



- Discrete State Examples
  - Hot Swap
  - CPU Error
  - Power Good
  - Thermal Trip

Monitors sensors resident on the components

Control

- Power Management:
  - Determines if the Shelf can supply the necessary power to a Module
  - Activate/Deactivate
- Electronic Keying:
  - Determines a matching configuration of the fabric and clock connections between the platform and payload board
- Boot Sequencing
  - Manages the sequence of payload board power up
- Hot Swap:
  - Manages the removal of a component (e.g., an AMC Module) from a platform and insertion of a new one while the power is still on and the system is still operating
- Fan Speed
  - Manages fan speeds and maintains a cooling policy that dynamically modifies the fan speeds based on temperature and fan speed events

Platform Management Fan Control

Platform Manager can…

- Adjust the total amount of air moving through the AMCs by changing the speed of the fans
- Increase the fan speed to increases the airflow and cooling capacity, or decrease the fan speed to increases fan life and decreases fan noise

Platform Manager Cooling Policy

- The shelf manager maintains a cooling policy that dynamically modifies the fan speeds based on temperature and fan speed events
  - The cooling policy maintains a “floating floor” for the fan speed in order to reduce fan speed oscillations
  - When upper temperature thresholds are crossed, the floor and fan speeds are raised
  - When temperatures return to normal, the fan speeds are gradually reduced to the floor
  - When temperatures remain normal for an extended period at the floor, the floor and fan speeds are periodically lowered

Cooling Policy Behavior

Trigger	Resulting Behavior
• Upper Non-Critical Temperature Event • Lower Non-Critical Fan Speed Event	The shelf manager increases the floor and gradually increases fan speed until the sensors return to the normal state or the maximum fan speed is reached
• Upper Critical Temperature Event • Lower Critical Fan Speed Event • Lower Non-Recoverable Fan Speed Event	The shelf manager increases the floor and sets the fans to maximum speed
• Upper Non-Recoverable Temperature Event	The shelf manager increases the floor, sets the fans to maximum speed, and deactivates the FRU reporting the upper non-recoverable temperature event. When the FRU's temperatures return to normal, the shelf manager waits a short period of time, and then reactivates the FRU.
• All Temperature Sensors and Fan Speed Sensors in the Normal Range.	If the fan speed is elevated above the floor, the shelf manager gradually reduces the fan speed until the floor is reached, an upper temperature event occurs, or a lower fan speed event occurs. If the cooling policy maintains a normal state at the floor for an extended period of time, the shelf manager periodically decreases the floor and the fan speeds.

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x86 Core 2 Duo Processor Cooling Management

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Intel® Core™ 2 Duo Thermal Management

- The Intel® Core™ 2 Duo has an on-die thermal diode used to monitor the processor's die temperature
- The AMC's MMC relies on the processor's thermal control circuit to manage the processor temperature
  - Modulates the processor core clocks or
  - Initiates an Enhanced Intel® SpeedStep® Technology clock speed transition when the processor reaches its maximum temperature
  - If the Intel thermal monitor fails, the host CPU generates a hardware signal THERMTRIP_L to immediately shut off power to the AMC module
- The maximum processor die temperature allowed by the Core 2 Duo processor is 100C with max ambient air temp of 55C

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Thank You

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