# MTCA next generation

## Chassis Cooling – a hot topic

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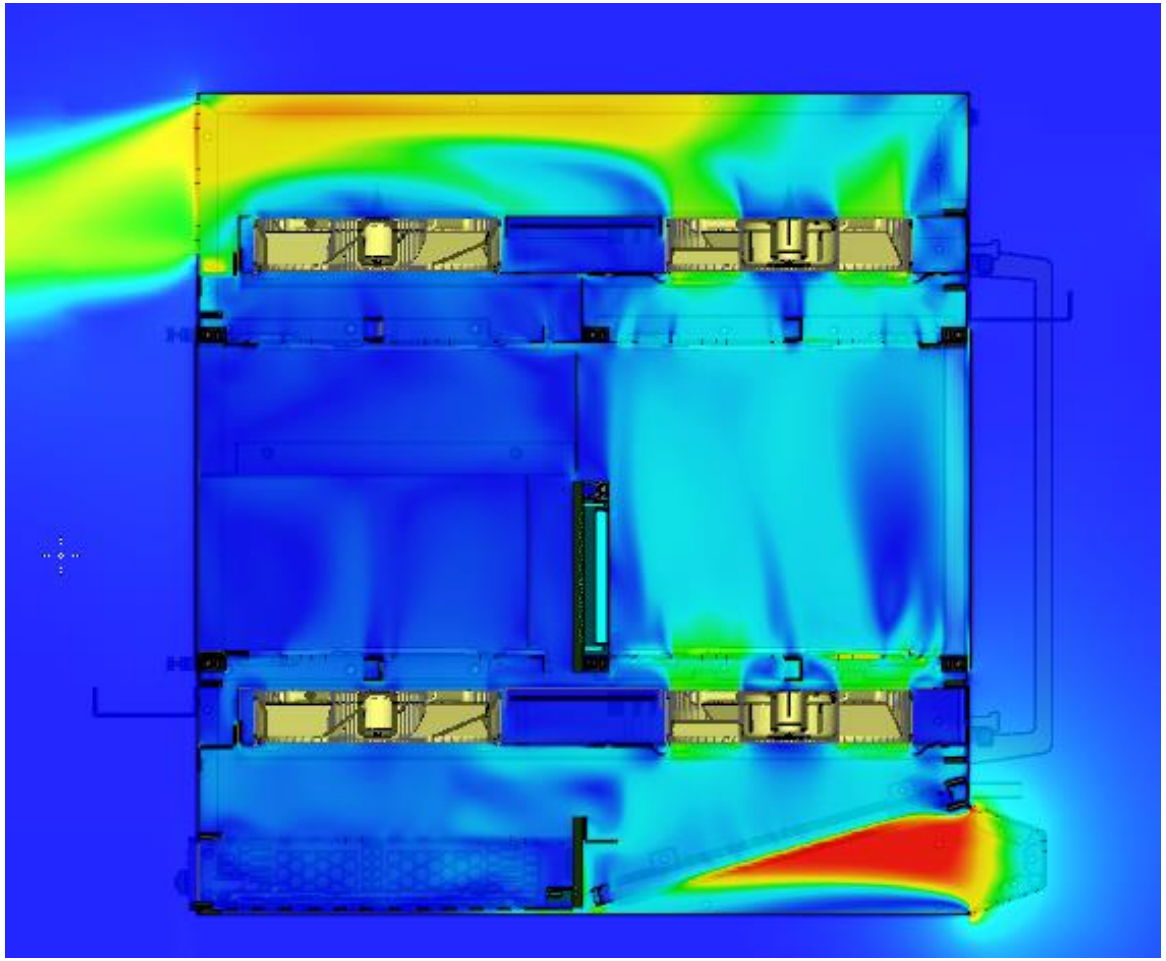
Dietmar Mann
nVent / Schroff GmbH

# Agenda

- Motivation / Starting point
- MTCA.4 crate cooling today
- Going beyond the current power limits
- Simulation model
- Calculation of required air flow
- Simulation results
- Conclusion



# Motivation / Starting point

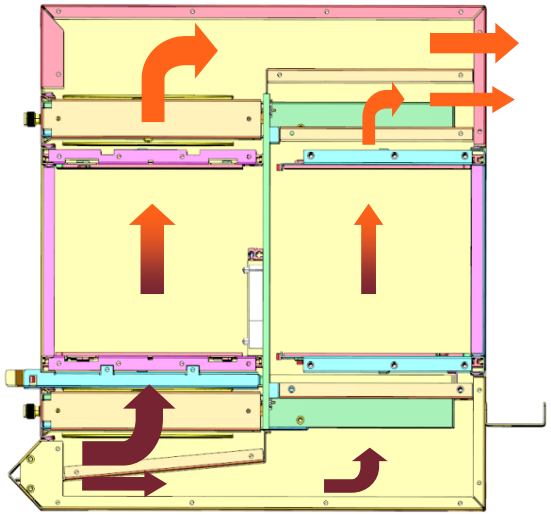
- MTCA currently limits the electrical power to the AMC to 80 W
- MTCA.4 limits the power to the RTM to 30 W (is deducted from the AMC power)
- Future applications require modules with more electrical power for latest processors and FPGAs
- A PICMG working group has been established to address this issues
- Preliminary goal:
  - AMC maximum electrical power 200W
  - RTM maximum electrical power 50W (is deducted from the AMC power)
  - Crate total power electrical budget 2000 W
- Also, the crate cooling system needs to be adapted

**Presenting first thermal simulation results, which addresses the need of more cooling.**

# MTCA.4 as it is today

MicroTCA.4 crate, 9 U, 84 HP, for 12 double mid-size AdvancedMC modules, 2 MCHs, 4PMs



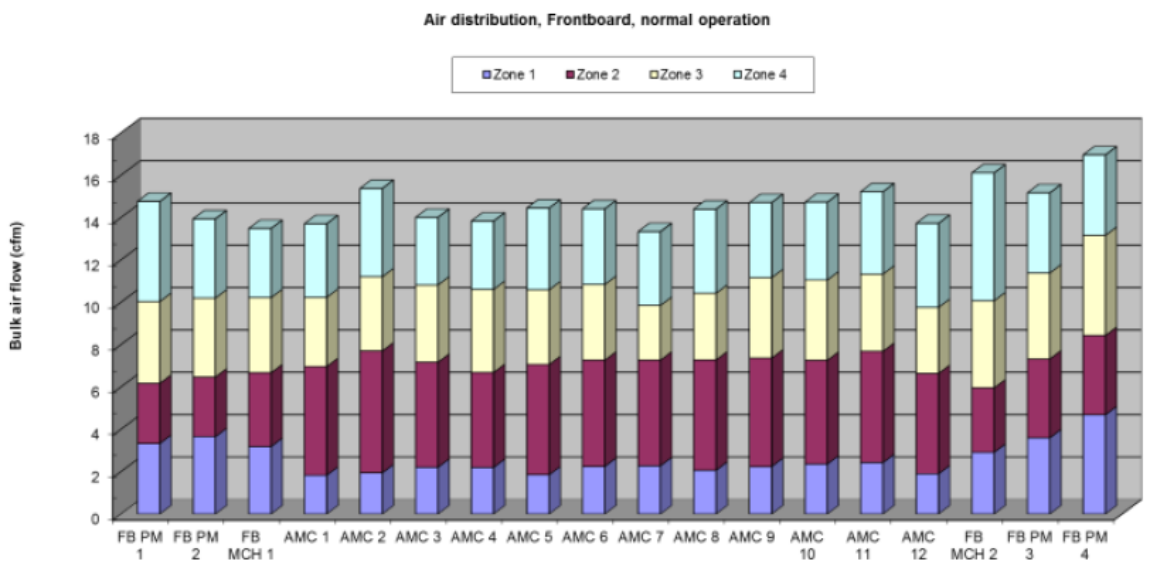


1 Upper Cooling Unit (CU1)
2 Lower Cooling Unit (CU2)
3 Air filter
4 ESD Wrist Strap Terminal
5 Cable Tray
6 Backplane
7 Card cage

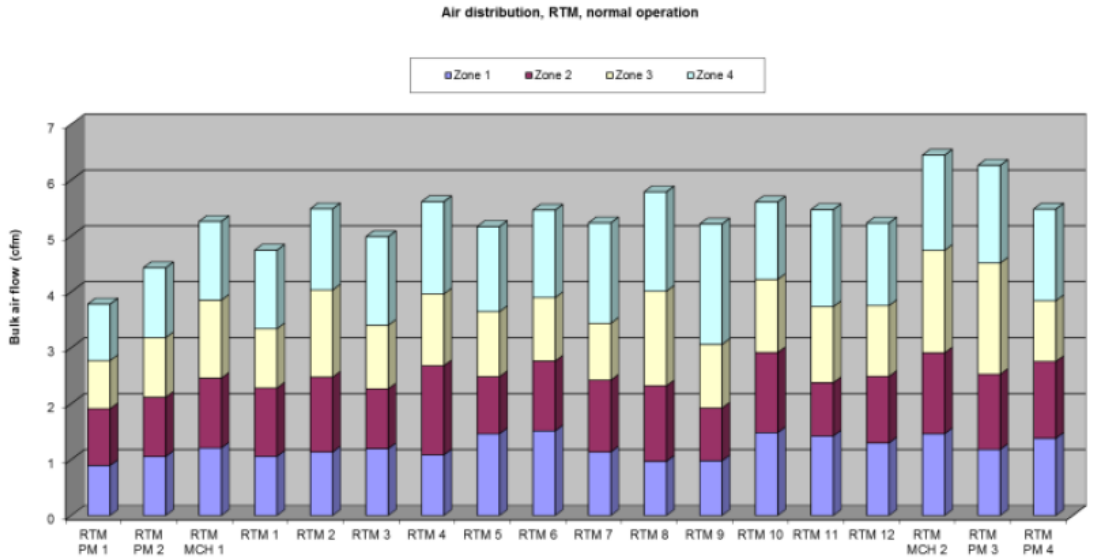
8 Rear card cage
9 Cable Tray
10 Ground Terminal

# MTCA.4 as it is today

- AMC slot 1: 24.3 m3/h
  - cooling capability (at ΔT=12k) ~ 88 W

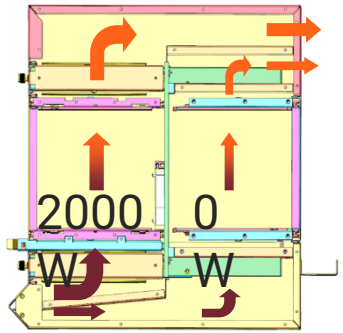


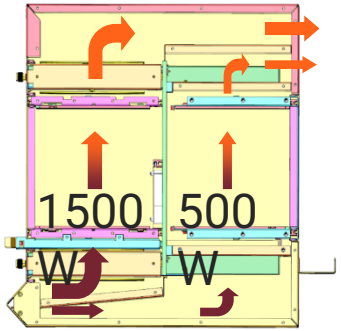

- RTM slot 7: 12.1 m3/h
  - cooling capability (at ΔT=12k) ~ 44 W

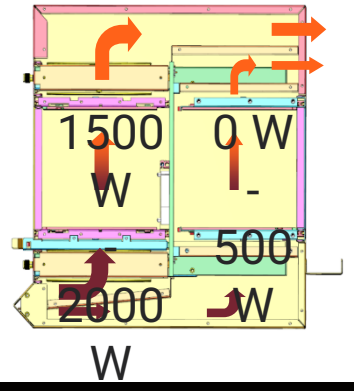


# Going beyond the current Power limits

- Simulation have been carried out to determine the cooling capabilities with different fan configurations
- Total electrical power in the shelf limited to 2000W
- Cooling load scenarios:
  - All electrical power consumed on the AMCs
    => Front card cage: 2000 W cooling
    => Rear Card cage: 0 W cooling
  - RTMs consume max. power of 30 W / 50 W
    => Front card cage: ~ 1500 W cooling
    => Rear Card cage: ~ 500 W cooling
  - Mixed cooling load
    => Front card cage: ~ 1500 W – 2000 W cooling
    => Rear Card cage: 0 W … ~ 500 W cooling
- Chassis cooling system needs to be able to handle all configuration



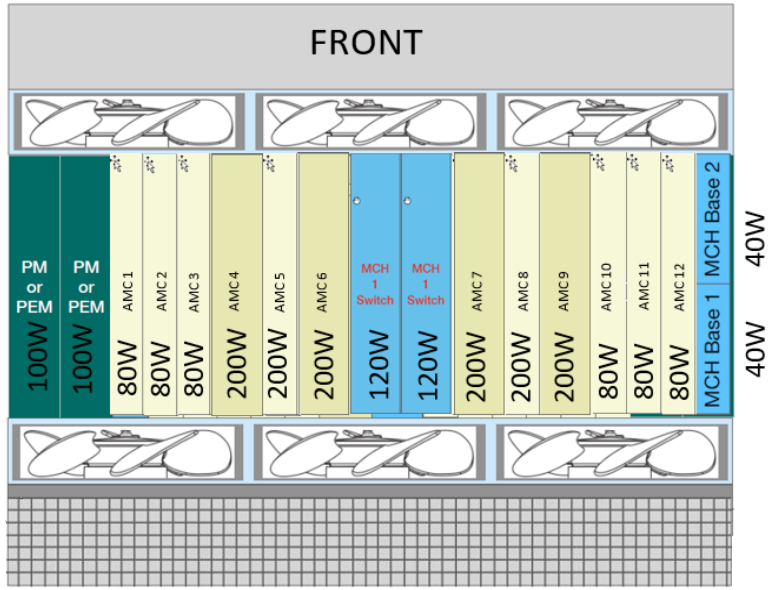



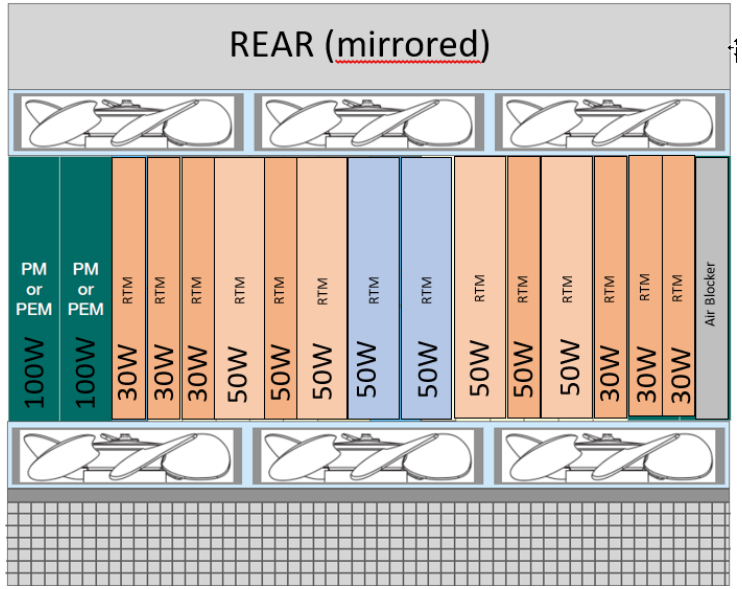
# Simulation model: Crate

- **Several cooling configurations have been simulated**
  - Push-Pull cooling, similar to existing 12-Slot crate
  - Pull cooling (fans at air exhaust at the top rear of the crate), without air guidance
  - Pull cooling (fans at air exhaust at the top rear of the crate), with air guidance

- **Constraints:**
  - Max. power consumption per Cooling Unit 200 W
  - Use of 12 V fans to stay compatible with 12V PP

- **Simulation model:**

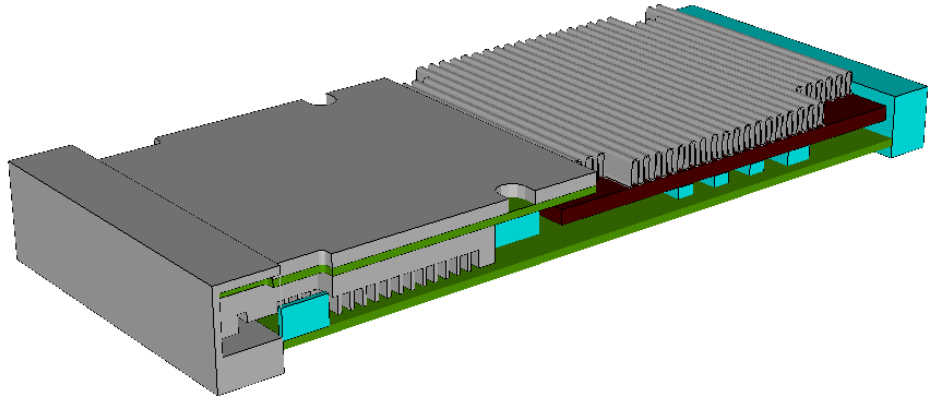


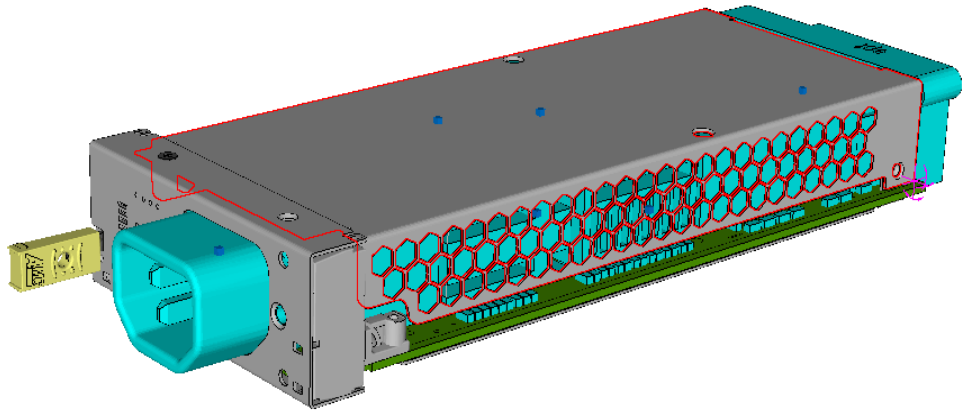
# Simulation model: Modules

- **Board models used for the simulation**

- **Model for a Mid Size Module (AMC and RTM)**
  - High air impedance
  - Used in previous simulations



- **Model for Full Size Module (AMC and RTM)**
  - High air impedance
  - Used in previous simulations



# Calculation of required air flow

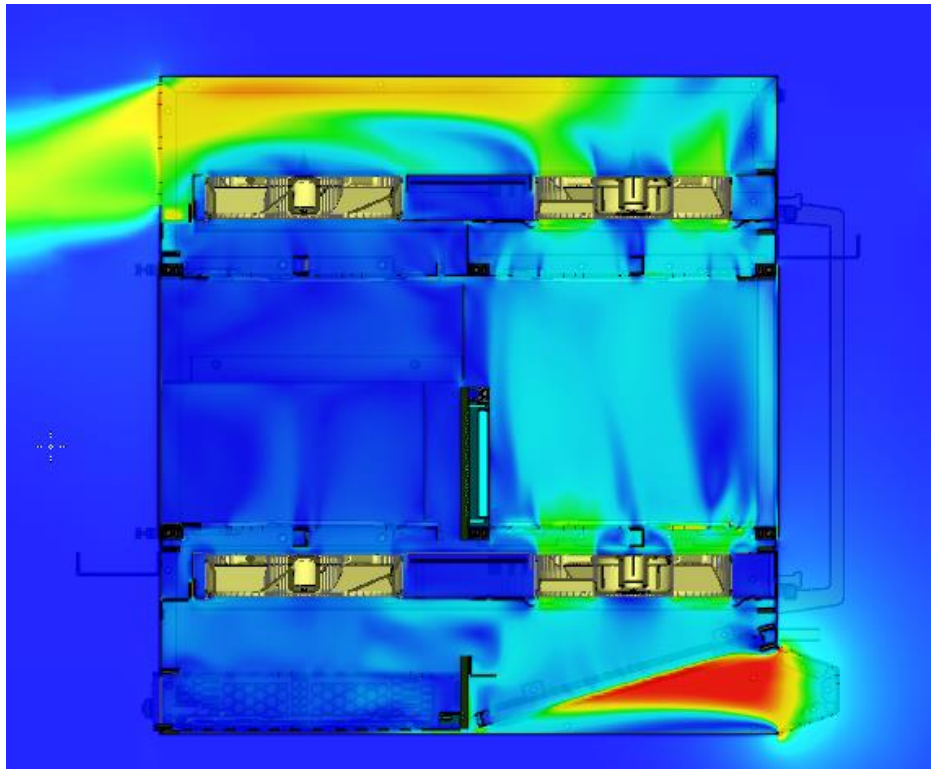
- **Formular used to calculate required air flow:**

- **$V = 3.3 \times P / \Delta T$**
  - V = Air Flow in $m^3/h$
  - P = Power required by the Module
  - ΔT = allowed temperature rise in the module, typically we use 12K…15K
  - 3.3 = coefficient

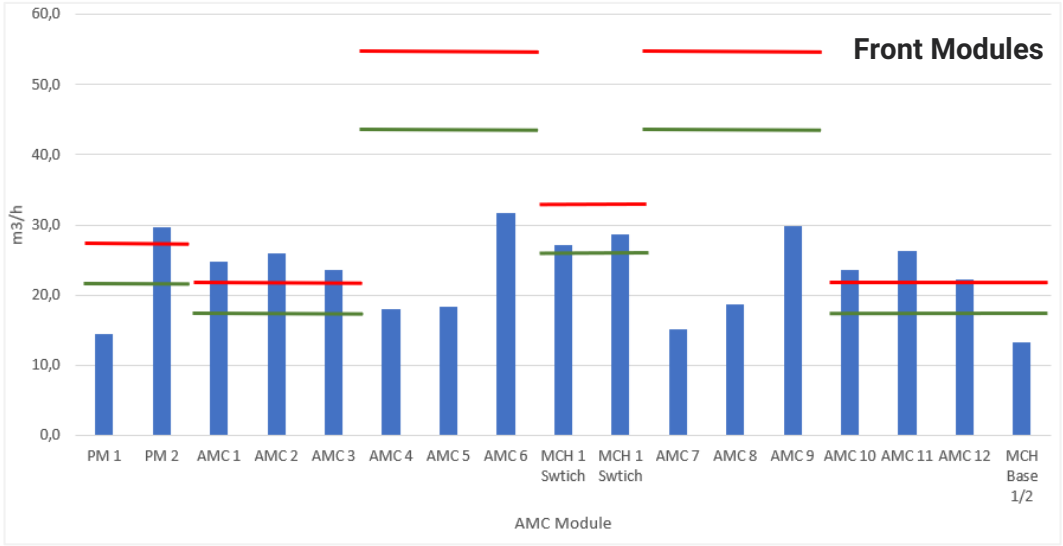
- **Example:**
  - AMC with 80 W power consumption: V = 3.3 x 80 W / 12K = 22 m3/h<br>V = 3.3 x 80 W / 15K = 17.6 m3/h
  - AMC with 200 W power consumption: V = 3.3 x 200 W / 12K = 55 m3/h<br>V = 3.3 x 200 W / 15K = 44 m3/h

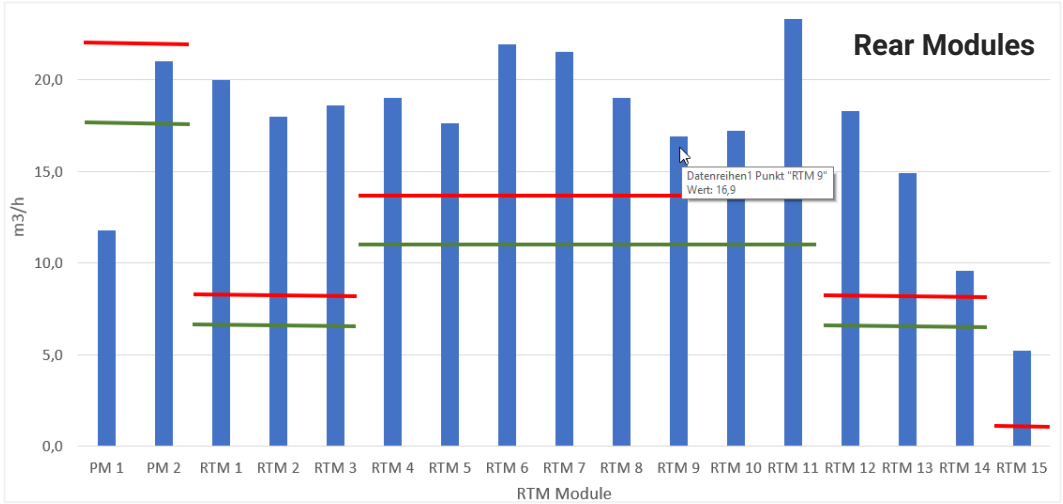
# Simulation result, Push-Pull

- **Push-Pull cooling, Air flow distribution per slot, like existing 12-Slot crate**



Crate side view



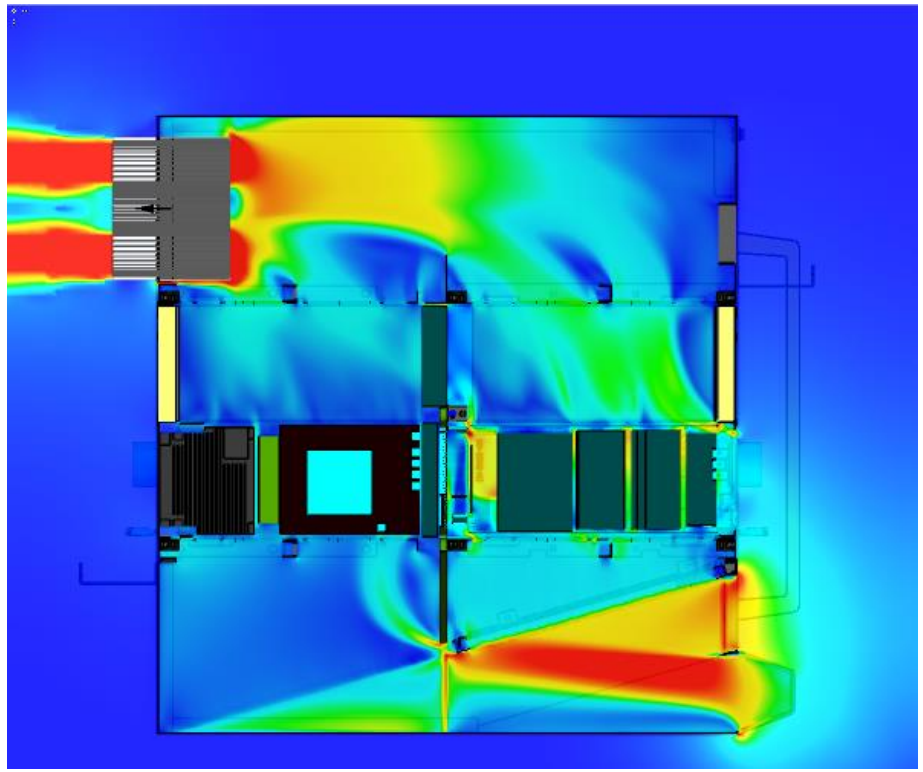




Required air flow with ΔT 15K

Required air flow with ΔT 12K

# Simulation result, Pull, without air guidance

- **Pull cooling (fans at air exhaust at the top rear of the crate), without air guidance**



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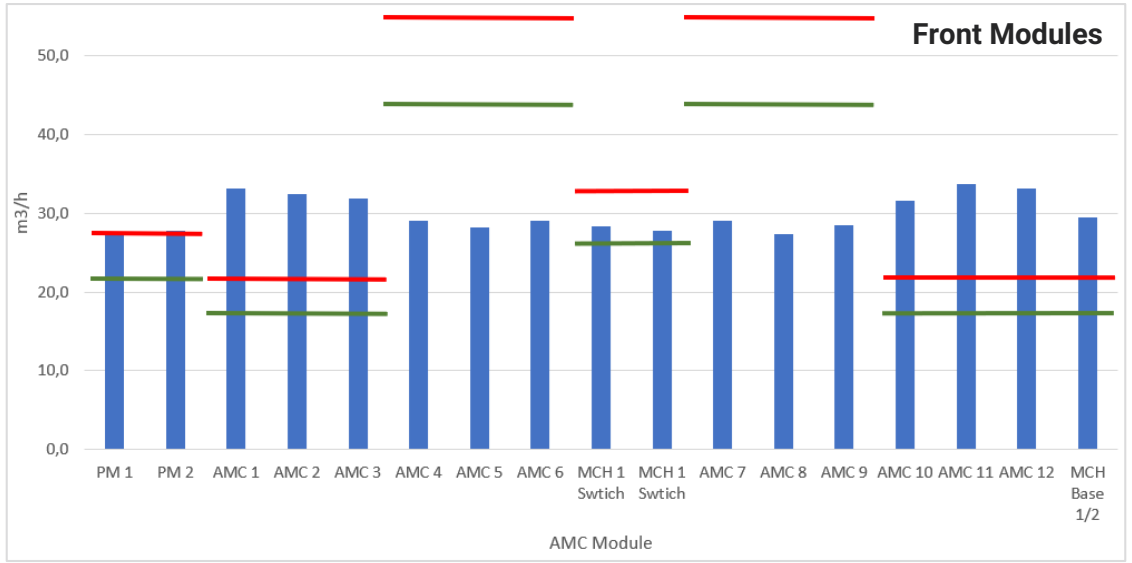
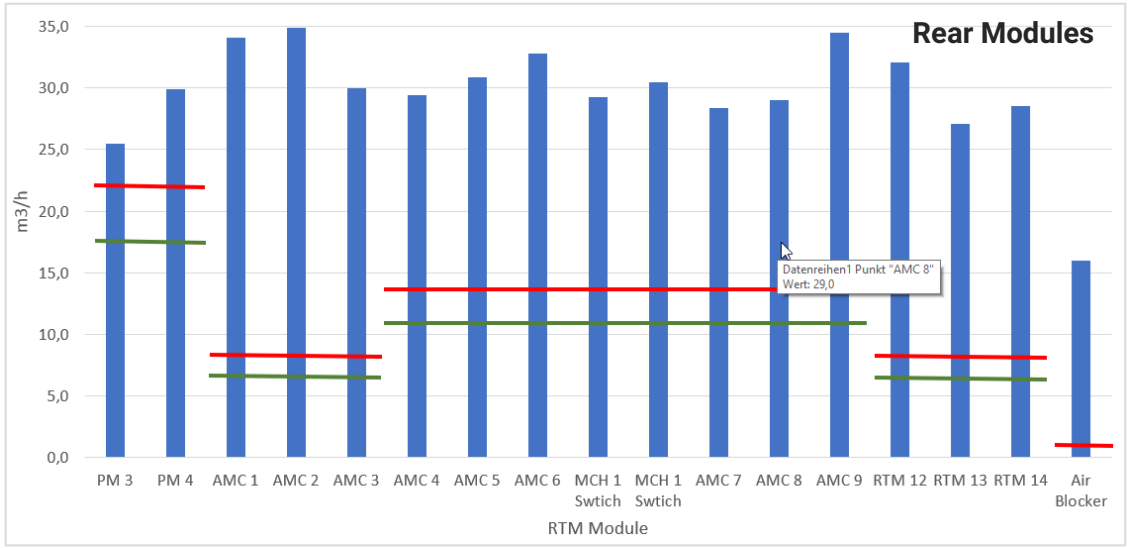
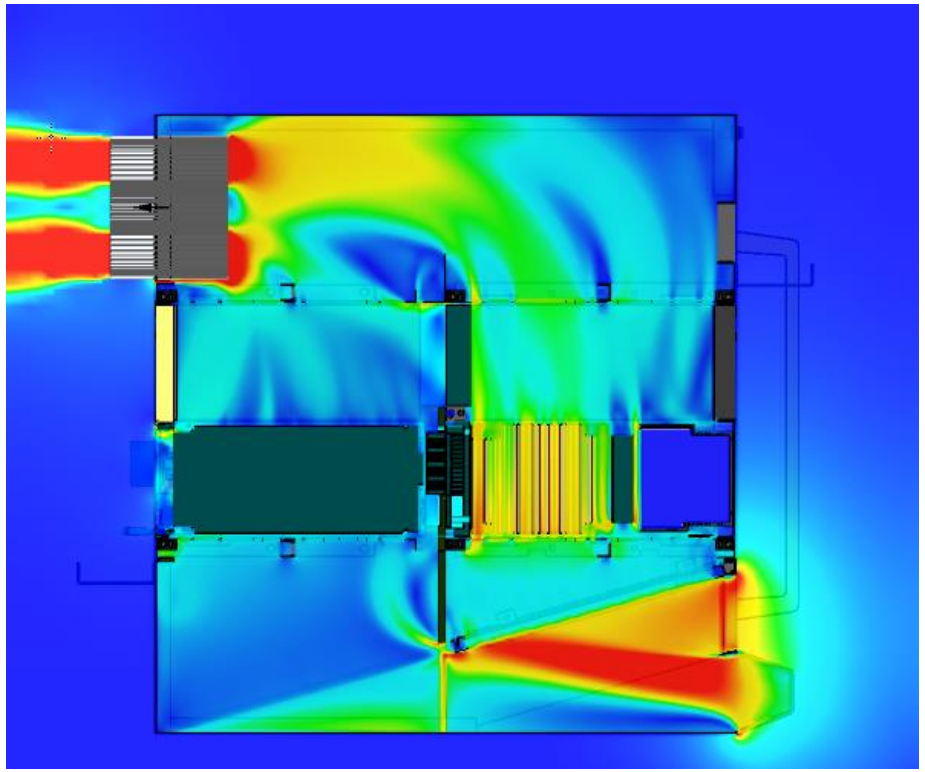


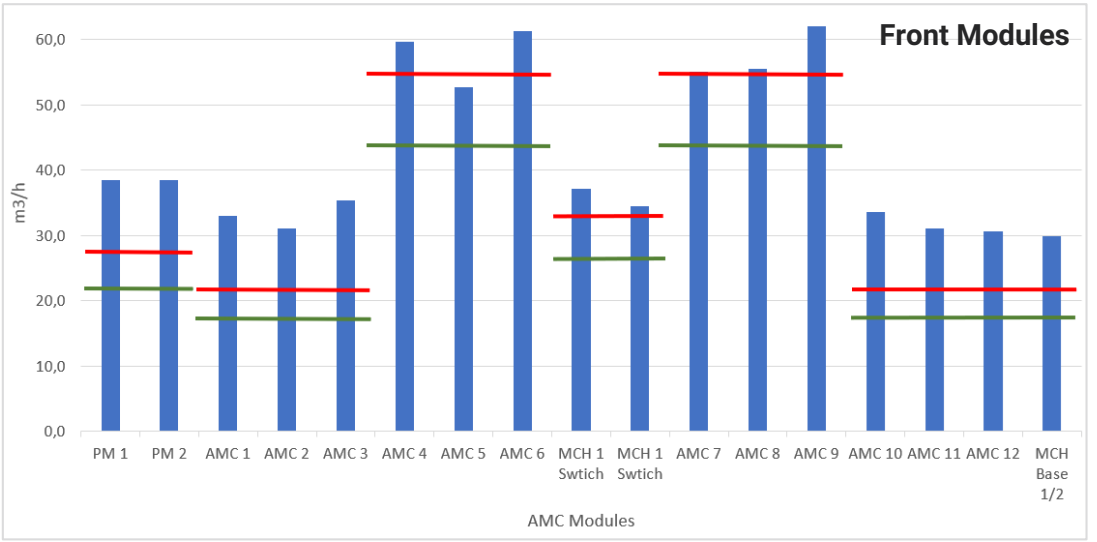

Required air flow with ΔT 15K  Required air flow with ΔT 12K

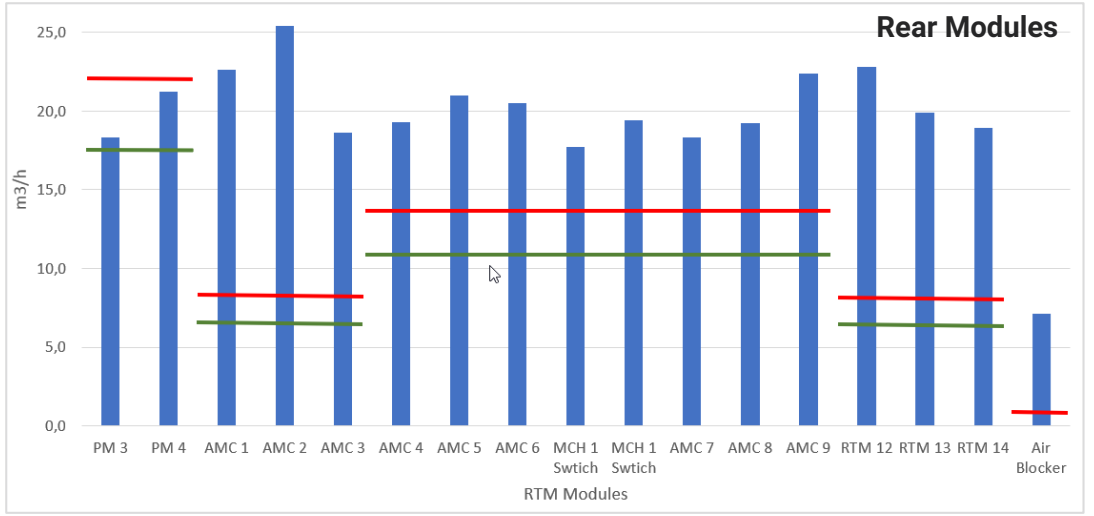
# Simulation result, Pull, with air guidance

- **Pull cooling (fans at air exhaust at the top rear of the crate), with air guidance**



Crate side view




Required air flow with ΔT 15K

Required air flow with ΔT 12K

# Conclusion

- Simulation results show that cooling of High-Power Modules of up to 200 W is possible
- Pull fan configuration seems to be more suitable than push-pull fan arrangement
- Required fan power is an issue, needs careful selection of fans
- Also fan acoustic noise needs to be considered
- Challenge to balance the air between front / rear and between the slots
- Careful Air guidance / blockage required to guide the air to High-Power Module slots

# Thank you!