Adaption
Cabinet to Crate Cooling

Cooling Strategies

Ralf Waldt/FAE
December 06, 2018
MTCA Workshop 2018

nVent

Agenda

- Planning cooling concept
- Calculation of the total heat dissipation
- Cooling solutions on crate level
- Cooling solutions on cabinet level
- Crate configuration vs cabinet cooling
- Additional considerations
- Thermal simulation
- Conclusion

Planning cooling concept

The planning of a cabinet cooling concept requires to considered different items for an optimal cooling concept

- **Cooling concepts of all integrated crates**
- **Total heat dissipation of all integrated crates**
- **Max. acceptable temperature increase**
- **Environmental conditions (temperature, dust, IP protection, etc.)**
- **Infrastructure (installation site)**
- **Noise requirements**
- **Redundancy**
- **Emergency concepts**

Calculation of total heat dissipation

EXAMPLE:

POWER LOSSES IN A MTCA.4.1 CRATE

- 12x >80 W per AMC / RTM slot -> > 1000 W heat dissipation
- 2x MCH + RTM -> 160 W
- 2x Cooling units -> 160 W
- Power modules (88% efficiency) ~ 300 W heat dissipation

=> Crate heat dissipation > 1.6 kW

POWER LOSSES IN THE WHOLE CABINET

3 MTCA Crates + other Electronics

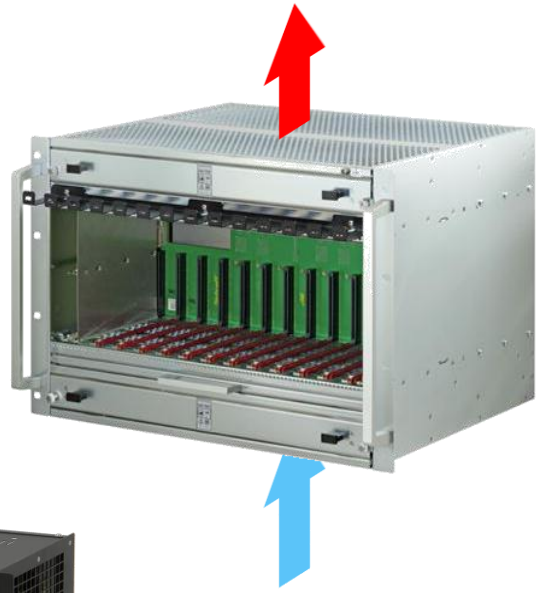
=> Cabinet heat dissipation 5 to 10 kW

Cooling solutions on crate level

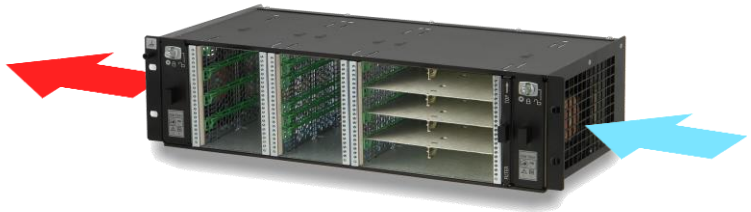
Common cooling concepts for crates

- Front-to rear air flow

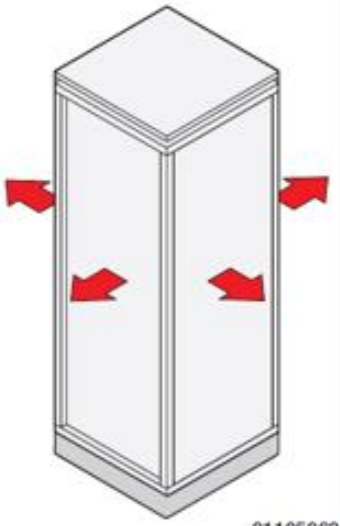
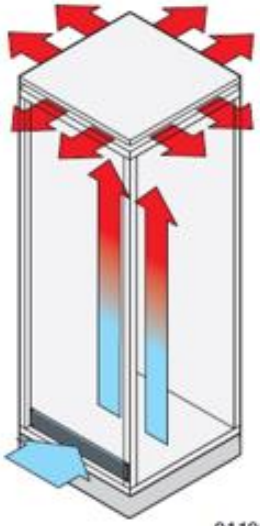
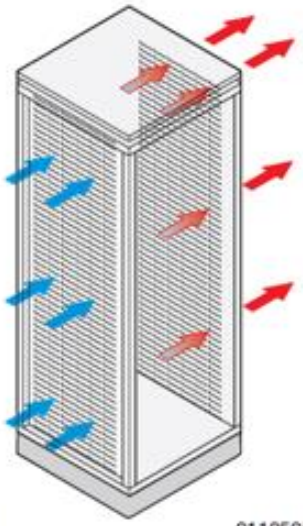
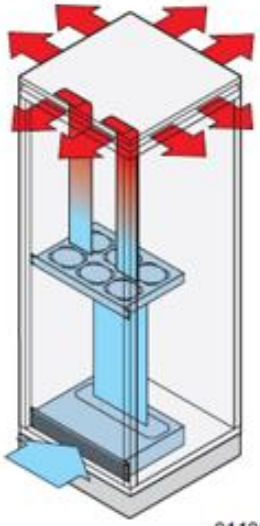
- Bottom-to-top cooling air flow



- Right-to-left air flow

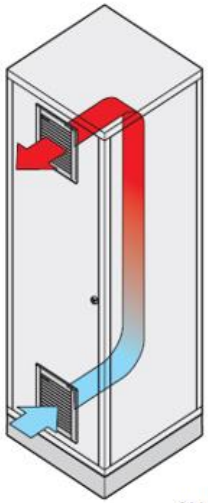
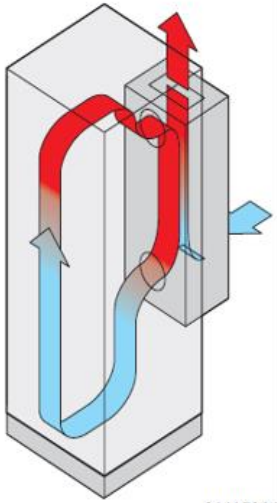
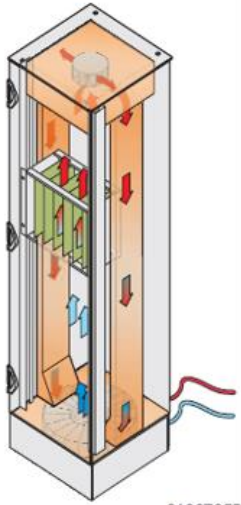
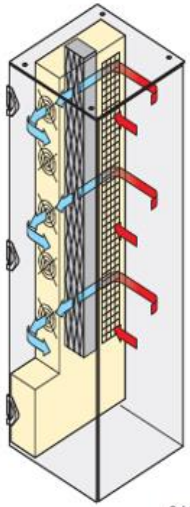
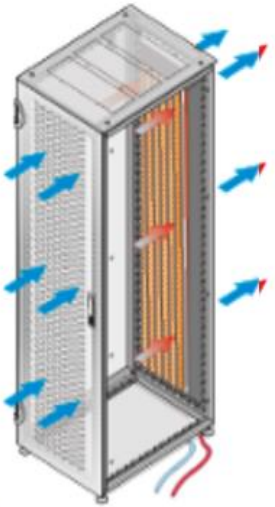


Cooling concepts on cabinet level

Product	Plain cabinet	Raised top cover, vent slots	Perforated doors	19" fans, top cover fans
Cooling concept	 01105060	 01105058	 01105056	 01105057
Description	Natural convection through radiation	Free convection through top cover opening	Free convection through opening in the doors/rear panels	Air cooling
Type of protection	⩽ IP 55	⩽ IP 20	⩽ IP 20	⩽ IP 20
Noise level approx.	0	0	55 ... 65 dB(A)	34 ... 67 dB(A)
Ambient conditions	$T_i > T_a$	$T_i > T_a$	$T_i > T_a$	$T_i > T_a$
Cooling capacity approx[1)]	< 500 W	500 W ... 800 W	500 W ... 6000 W [2)]	< 2000 W

1) depending on cabinet size, electronic components, location and room cooling concept
2) > 800 W are only possible with own, active cooling through components
T_i = cabinet inner temperature T_a = cabinet ambient temperature

Cooling concepts on cabinet level

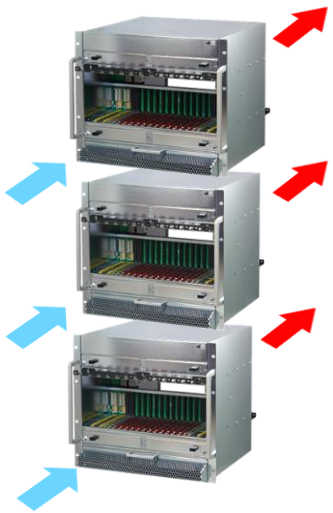
Product	Air filtered fan	Climate equipment	Air / water heat exchanger LHX 3	Air / water-heat exchanger LHX 20/40	Door cooler with integrated air / water heat exchanger
Cooling concept	 01102050	 01105061	 01007055	 01005081	
Description	Cooling with air	Cooling with air	Air conditioner	Cooling with water	The air flow is pushed by the fans of the crates
Type of protection	≤ IP 54	≥ IP 55	≥ IP 55	≥ IP 55	≤ IP 20
Noise level approx.	39 ... 71 dB(A)	60 ... 81 dB(A)	45,2 dB(A)	50 ... 70 dB(A)	0 dB(A)
Ambient conditions	$T_i > T_a$	$T_a \leq 55°C$	$T_a \leq 70°C$	$T_a \leq 70°C$	$T_i > T_a$
Cooling capacity approx.[1)]	< 1500 W	< 2600 W	< 3000 W	< 40000 W	< 15000 W

1) depending on cabinet size, electronic components , location and room cooling concept
T_i = cabinet inner temperature T_a = cabinet ambient temperature

Crate configuration vs cabinet cooling

Cabinet configuration only with crates

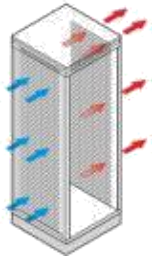
front-to rear air flow



Cabinet cooling

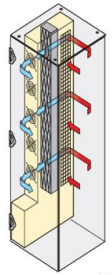
Best solutions

Perforated doors



Rear door cooler

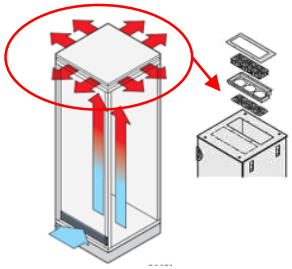
Air/water heat exchanger



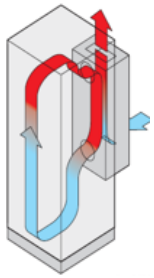
- **High cooling efficiency due to low air resistance.**
- **Easy to separate the cold and the warm air area with air baffles beside the 19” frame.**

Further solutions but with lower efficiency

Raised top cover with fans



Climatic equipment



Additional bypasses for air flow necessary are reducing the efficiency
-> Higher input power required
-> Higher noise level

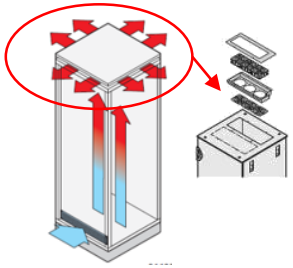
Crate configuration vs cabinet cooling

Cabinet configuration only with crates bottom-to-top air flow

Cabinet cooling

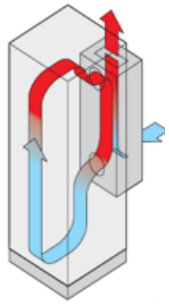
Best solutions

Raised top cover with fans



Air/water heat exchanger

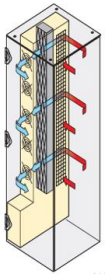
Climatic equipment



- **High cooling efficiency due to low air resistance.**
- **Easy to separate the cold and the warm air area with air baffles beside the 19” frame.**

Further solutions but with lower efficiency

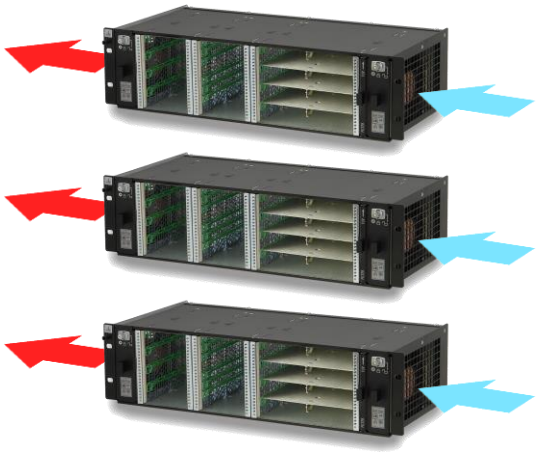
Air/water heat exchanger



Additional bypasses for air flow necessary are reducing the efficiency -> Higher input power required

Crate configuration vs cabinet cooling

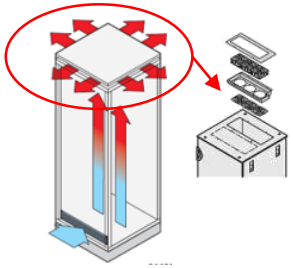
Cabinet configuration only with crates right-to-left air flow



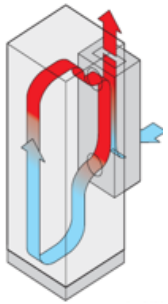
Cabinet cooling

Best solutions

Raised top cover with fans



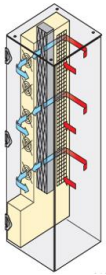
Climatic equipment



- **High cooling efficiency due to low air resistance.**
- **Easy to separate the cold and the warm air area with air baffles beside the 19” frame.**

Further solutions but with lower efficiency

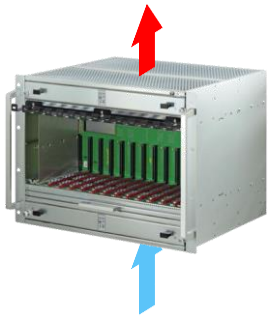
Air/water heat exchanger



Additional bypasses for air flow necessary are reducing the efficiency
-> Higher input power required
-> Higher noise level

Crate configuration vs cabinet cooling

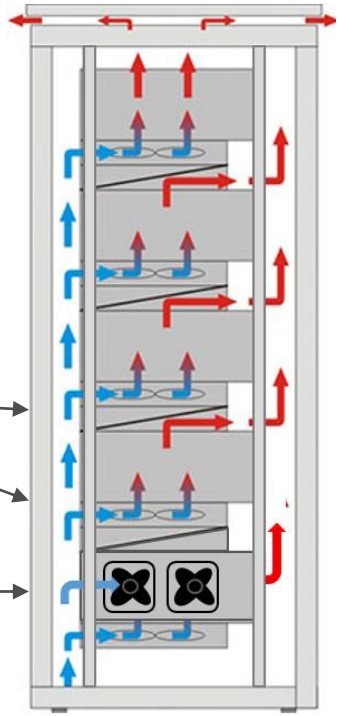
Cabinet configuration with different cooling concepts of the crate are the worst case



Cabinet cooling

- High efforts to separate the cold air flow and the warm air flow.
- Additional bypasses for air flow necessary are reducing the efficiency

-> Higher input power required
-> Higher noise level
-> Lower assembly space due to additional air guiding components



Workaround

Addional considerations

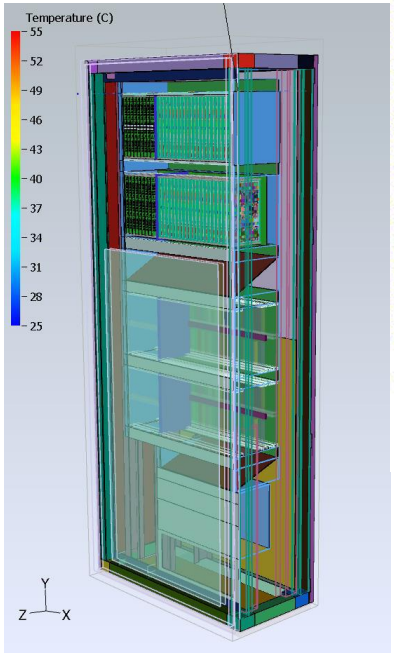
- Air filter a providing an air resistance and reducing the air volume
- Infrastructure (installation site):
  What cooling solution are fitting to the installation site in view of space, temperature, humidity, etc.
  Is water connection available?
- Redundancy: Power, cooling, etc.
- Emergency concepts: Door opening, alternative cooling concept, shutters, etc.

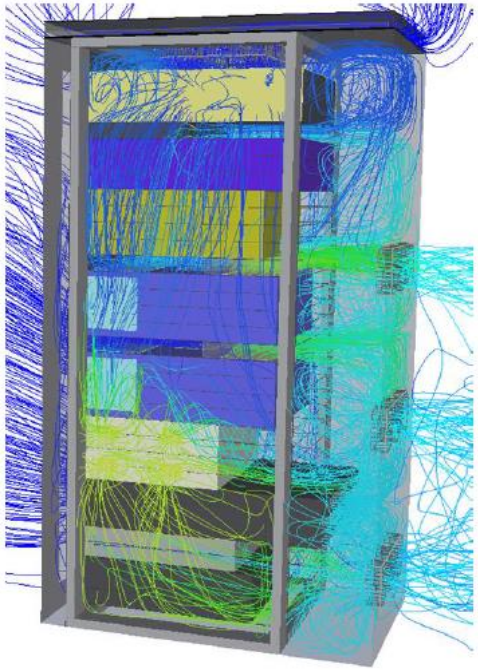
Thermal Simulation

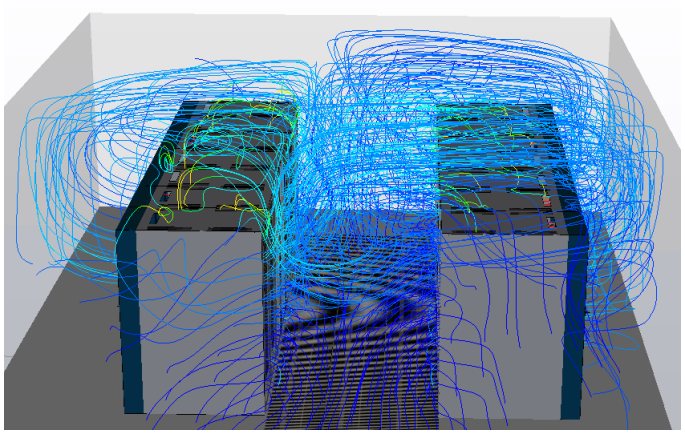
Thermal simulation will provide proper support for designing the optimal cooling concept especially for critical applications.

Simulation critireas:

- **Air flow**
- **Velocity**
- **Pressure**



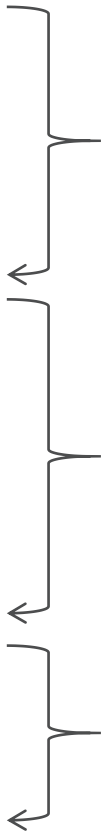




The results of the thermal simulation are platform for further decisions.

Conclusion

- Cooling concepts of all integrated crates
- Total heat dissipation of all integrated crates
- Max. acceptable temperature increase
- Environmental conditions (temperature, dust, IP protection, etc.)
- Infrastructure (installation site)
- Noise requirements
- Redundancy
- Emergency concepts



Cabinet (enclosure)

+ Cooling requirements

+ Environmental conditions

+ Safety requirements

= Cooling solution

Thank you