News from the xTCA evaluation program - part 2

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9th meeting of the xTCA interest group

Outline

- MTCA shelf and PM technical specification and price enquiry
  - Evaluated MicroTCA commercial equipment
  - Equipment customization towards a common shelf for use in the LHC experiments.
  - Technical specification key points
  - Price enquiry outcome
  - Next steps
- ATCA in rack vertical airflow simulation study
  - Simulation and rack layout baseline
  - Scenarios, first results and recommandations

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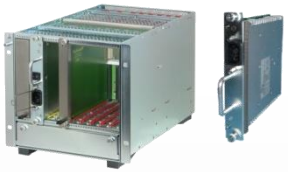
Evaluated MicroTCA commercial equipment (reminder)

MicroTCA Crates

Vadatech MTCA.0
VT892

Schroff MTCA.4
11890

Schroff MTCA.4 + AC/DC CM100



ELMA MTCA.4
043-012

ELMA MTCA.4
045-821

ELMA Blu!Eco

Power Modules (PM)

NAT DC840
840W

Vadatech
UTC010 792W

Vadatech
UTC020 936W

Wiener AC/DC
1000W

Telkoor AC/DC
600W

NAT AC/DC
AC600 600W

AMCs

ELMA Load Board

Processor
Kontron AM5030

ESD ADIO24

Processor
CCT AM310

MicroTCA Carrier Hubs (MCH)

Vadatech
UTC001

NAT

Kontron
AM4904

Evaluated MicroTCA commercial equipment

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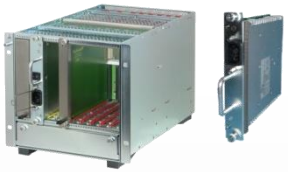

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Equipment customization towards a common shelf for use in the LHC expts

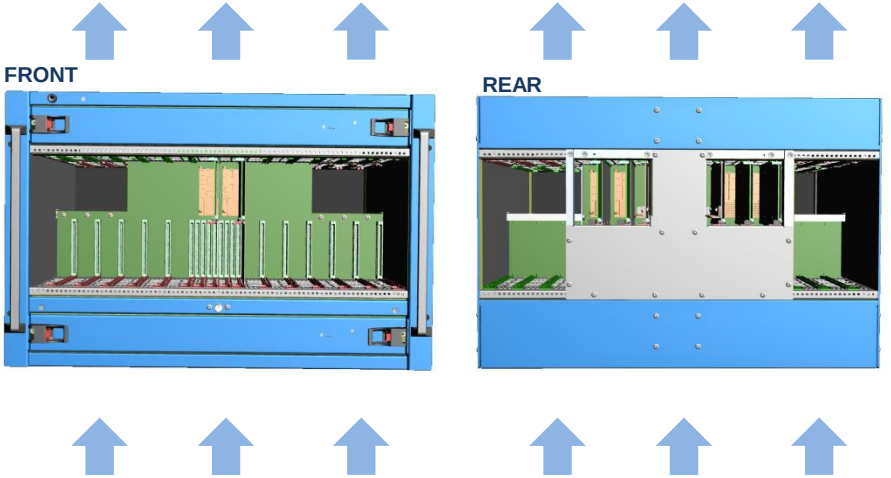
Custom design for CMS and some additional ideas:

- 12 full size - double width AMCs
- 6 Rear Transition Modules
- 6 Power Modules (Two front – Four Rear)
- 2 MCHs
- Vertical airflow
- Clock distribution according to CMS requirements

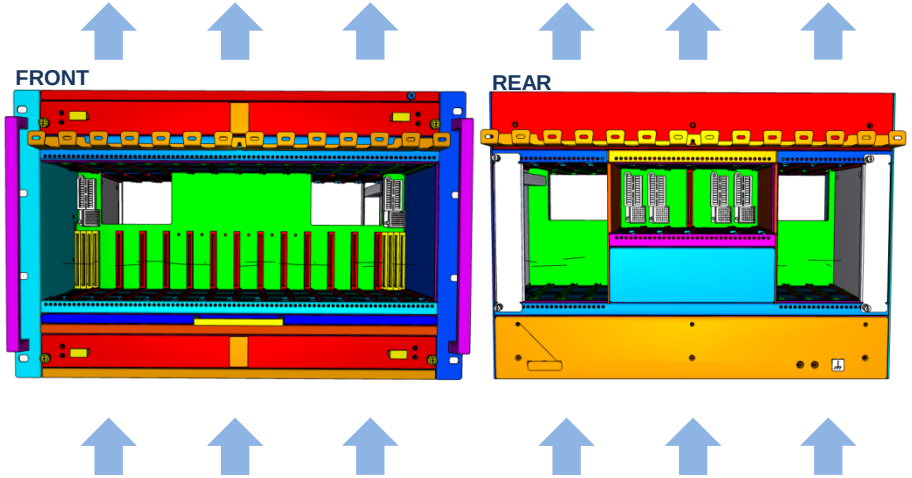
→

Installation and format flexibility
Power density
Easy to adapt to existing cooling management

ELMA



Schroff



Technical specifications key points (Shelf)

Physical shelf baseline:

- 19” rack system compatible card cage with a maximum height of 10U.
- Card cage compatible with in-rack vertical air flow.
- 12 full-size, double width AMC slots
- 6 RTM slots (as defined in the PICMG MTCA.4 standard)
- 2 MCH slots
- 4 (optionally up to 6) full size, single width PM slots
- 1 mid-size or full-size (preferred) JSM (JTAG switch module) slot (optional).

Module location and accessibility:

- Front access:
  - 2 MCH
  - 12 AMC
  - 2 CU
  - 2 PM (optional)
- Rear access:
  - 4 PM
  - 6 RTM
  - 1 JSM (optional)

Backplane requirements (10Gbps):

Variant 1 (MTCA.4):

- Port topology: All AMC ports routed as per PICMG MTCA.4
- Clock distribution topology: All clock lines routed as per PICMG MTCA.4

Variant 2 (CERN custom):

- Port topology:
  - Dual-star routing of AMC Fabrics A, B, D, E, F, G to MCH1 and MCH2
  - AMC ports 12-15 routed as per PICMG MTCA.4 standard.
  - AMC ports 17-20 routed as per PICMG MTCA.4 standard.
- Clock distribution topology:
  - MCH1 CLK1 to AMC TCLKA
  - MCH2 CLK1 to AMC FCLKA
  - AMC TCLKB to MCH1 CLK2 and MCH2 CLK2

Technical specifications key points (DC power module)

General requirements:

- Dual -48Vdc inputs.
- Minimum total (MP + PP) output power: 800W
- Total efficiency above 40% of maximum load: 90% minimum
- 16 output channels with individual payload power current monitoring via IPMI
- Support for N+1, 2+2 redundancy and shared load topologies.
- Full HPM.1 support (EMMC FW field upgrade via IPMI)

Electrical requirements:

- Input voltage range: -40 to -60 Vdc (no impact on available output power)
- Minimum isolation voltage: 1500V
- Payload power:
  - Output voltage accuracy: 12V ±10%
  - Minimum output power per channel: 80W (over the entire output voltage range)
  - Optional: Minimum output power per channel in non-redundant mode: 100W
  - Output voltage stability (including output voltage drift and over dynamic load variations): ± 200mV
  - Maximum output noise and ripple: 100mV peak to peak (30 MHz BW)
  - Output current monitoring for each output channel with a readout accuracy of 5%
- Management power:
  - Voltage accuracy: 3.3V ±5%
  - Maximum output noise and ripple: 100mV peak to peak (30 MHz BW)
  - Current available per channel: minimum 150mA
  - Fast trip current limit: 225mA (in redundant mode)

Price enquiry outcome

MTCA Shelves (40 pcs)

Manufacturer	ELMA	Schroff	Vadatech
Compliant to spec	✓	✓	*No offer made*
Pros	Cooling efficiency except for slot 12 and RTM Layout with MCH in middle	Cooling homogeneity across slots Mechanical robustness Remote support quality	
To be done	Backplane quality meas.	Backplane quality meas.	

DC power modules (100 pcs)

Manufacturer	NAT (DC840, different sources)	Vadatech (UTC-010)	Vadatech (UTC-020)
Output power	840 W	750W	890W
Compliant to spec	✓	✗	✓
Pros	Efficiency 100% IPMI compliant	Std compliant MTBF Serial interface	Std compliant MTBF Serial interface

Evaluation reports available: https://espace.cern.ch/ph-dep-ESE-BE-uTCAEvaluationProject/default.aspx

Next steps

- Perform some lane characterisation measurements on shelf backplanes (ongoing)
- Perform technical evaluation of the Vadatech UTC-020 PM (ongoing)
- If required, issue the technical justification for the manufacturer selection
- Order pre-series of 3 units for final qualification
- Once approved, contracts can be used for simplified purchase order process through CERN
  (Planned for June 2015)

- Follow the same process for ATCA shelves

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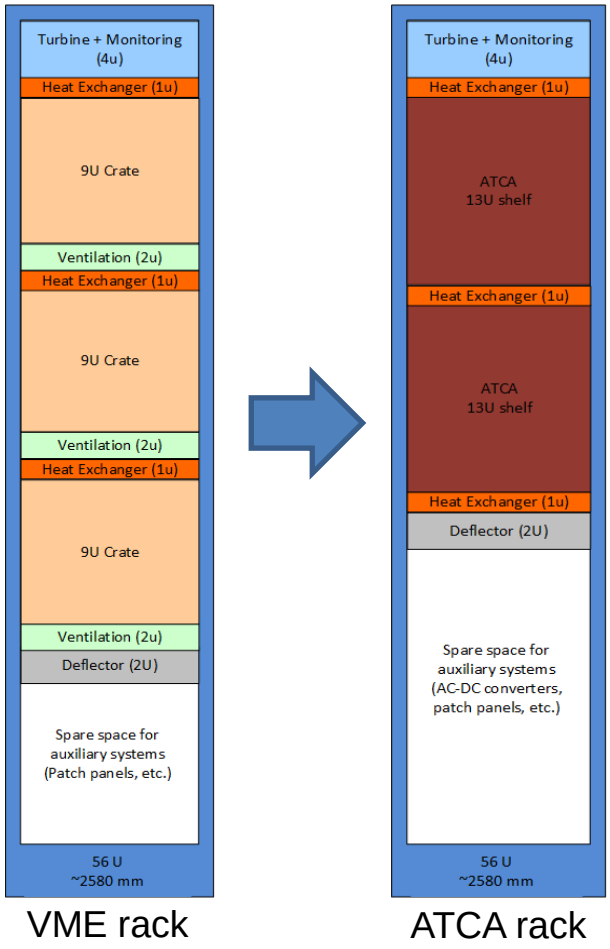
  - Scenarios, first results and recommandations

Simulation and rack layout baseline

Goal of the simulation study:

- Airflow simulation of an ATCA shelf in a standard LHC rack
- Thermal and airflow simulation results of a std LHC rack with 2 shelves and 1U heat exchangers
  - Simulation of different in-rack layout
  - With turbine in the rack
  - Without turbine blowers/chassis

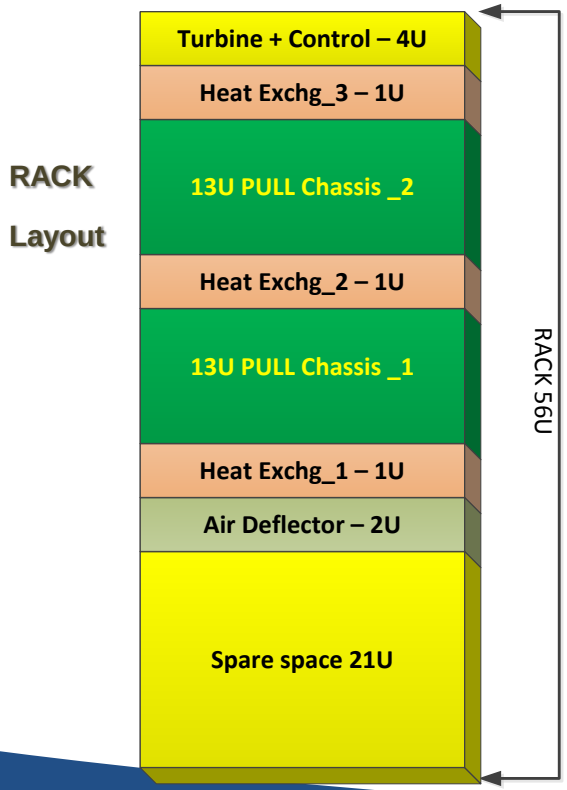
- Simulation performed by ASIS (shelf manufacturer)
- Layout of rack, turbine, heat exchanger and deflector given by CERN

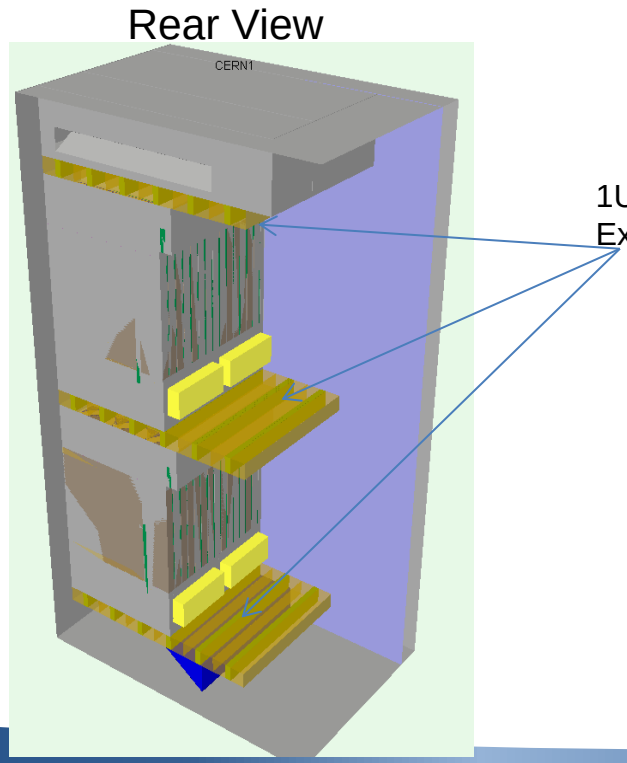


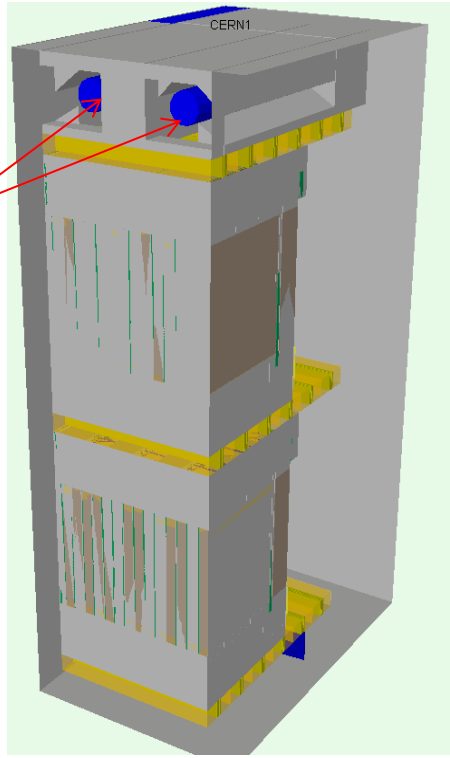
Scenarios, first results and recommendations

1. First simulation run

- 2 x 13U Asis Chassis.
- Chassis air flow bottom up.
- Up to 400W per blade, and 50W RTM
- Heat Exchange 1U, water cooling 16 C





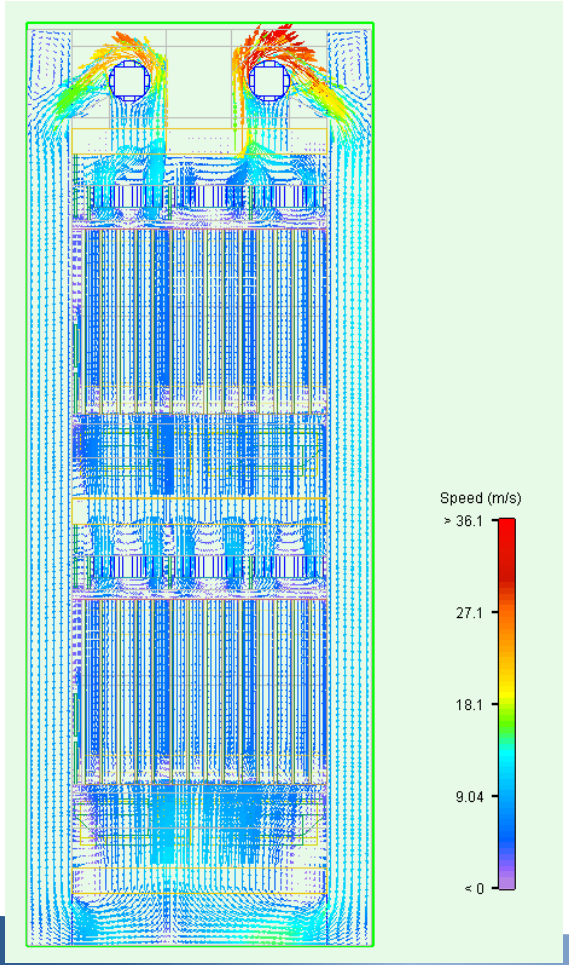


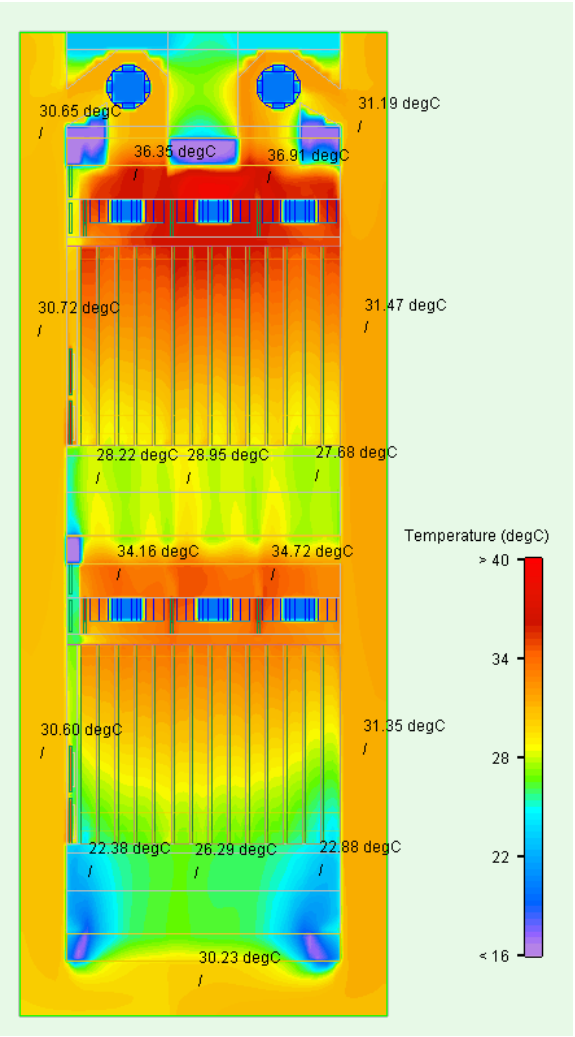
Scenarios, first results and recommendations

1. First simulation run

- MAX TEMP at Hot spots (FAN outlets of to chassis) is 37C.
- Delta T inside the chassis is ~12C.

- Air flow circulates via the gap of ~75mm on the RACK sides.
- Air speed on the side walls is 15m/s. It is driven by the top chassis FAN drawer
- Air flow bottleneck at the top turbine level. Suspected to induce important noise level. Air speed in excess of 35 m/s in this location





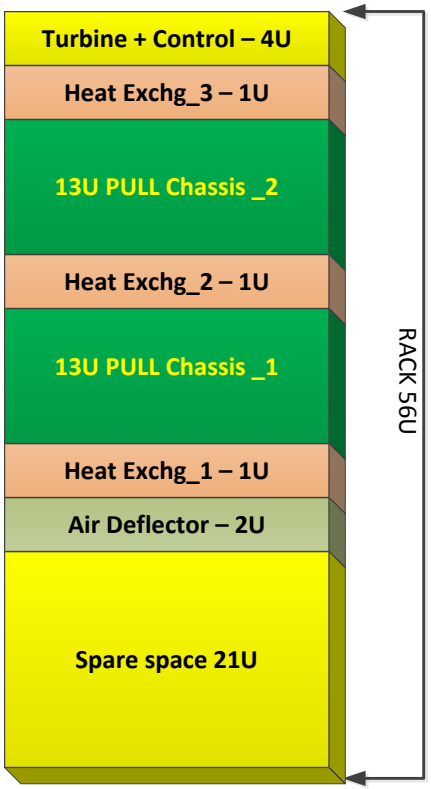
Air Flow Speed results

Scenarios, first results and recommendations

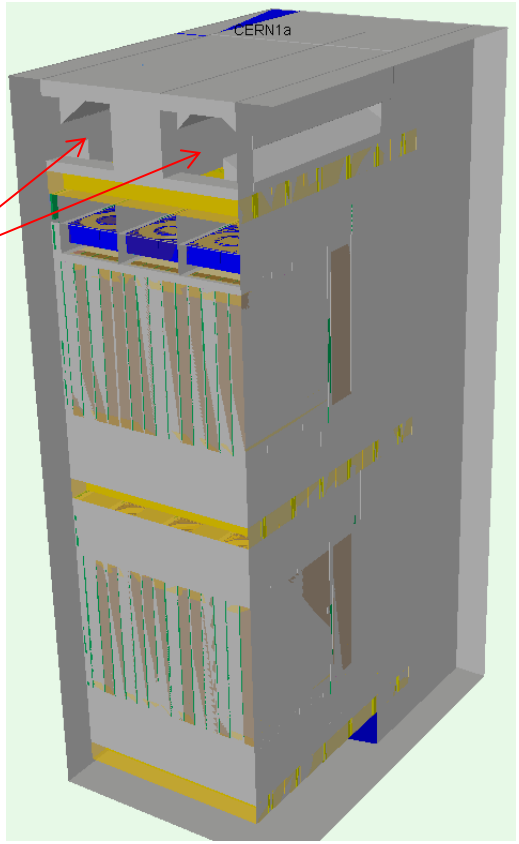
2. No turbine rotor simulation run

- Other conditions as in run 1

RACK Layout



Turbine without rotors

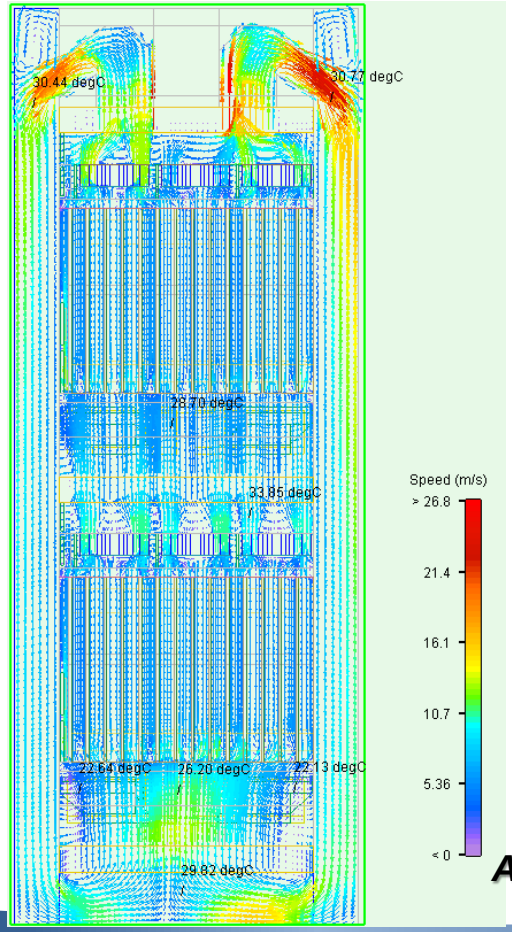


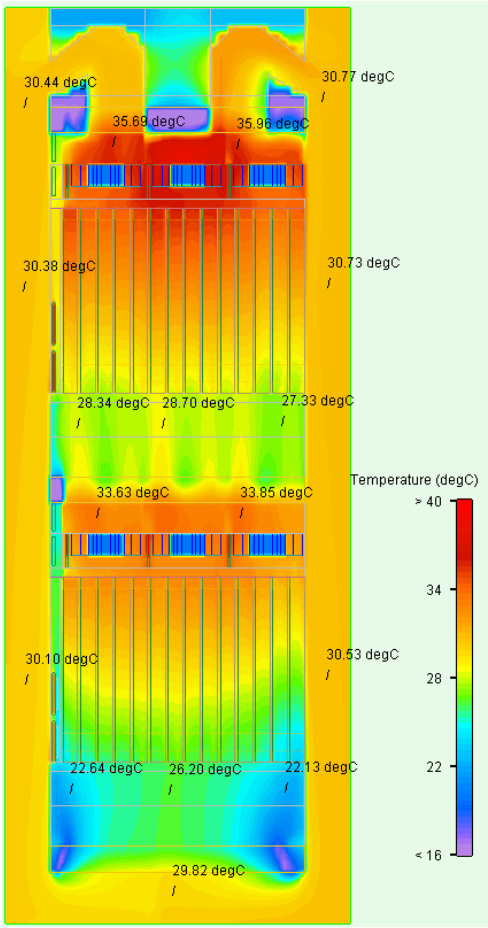
Scenarios, first results and recommendations

2. No turbine rotor simulation run

- MAX TEMP at Hot spots (FAN outlets of to chassis) is 36C.
- Delta T inside the chassis is ~12C.

- Air flow circulates more easily in/via the turbine chassis.
- Still a bottleneck at the top turbine. Suspected to induce important noise level. Air speed reduced to 25-26 m/s.





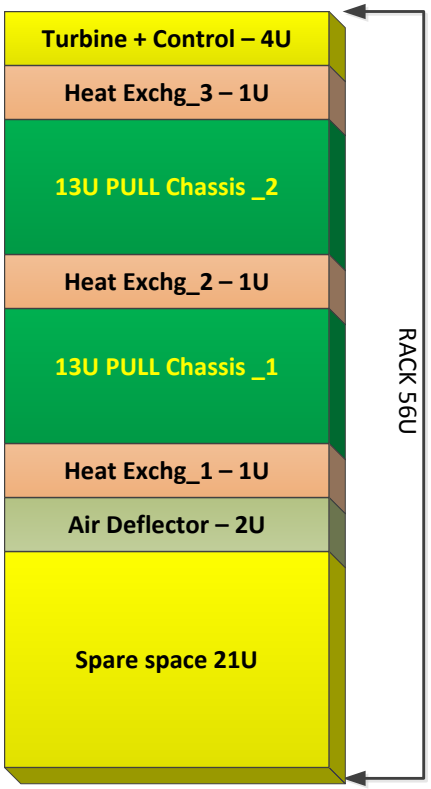
Air Flow Speed results

Scenarios, first results and recommendations

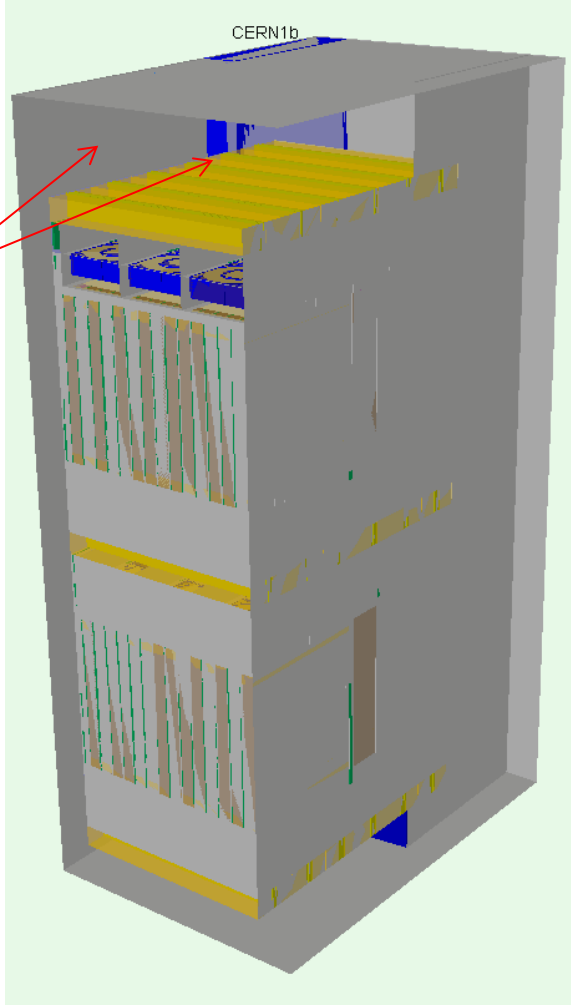
3. No turbine chassis simulation run

- Other conditions as in run 1

RACK Layout



Turbine is removed entirely

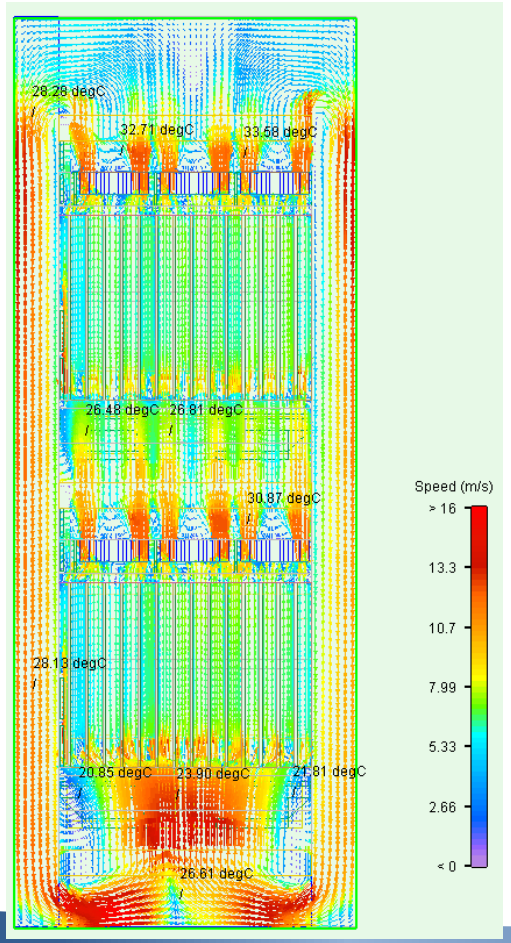


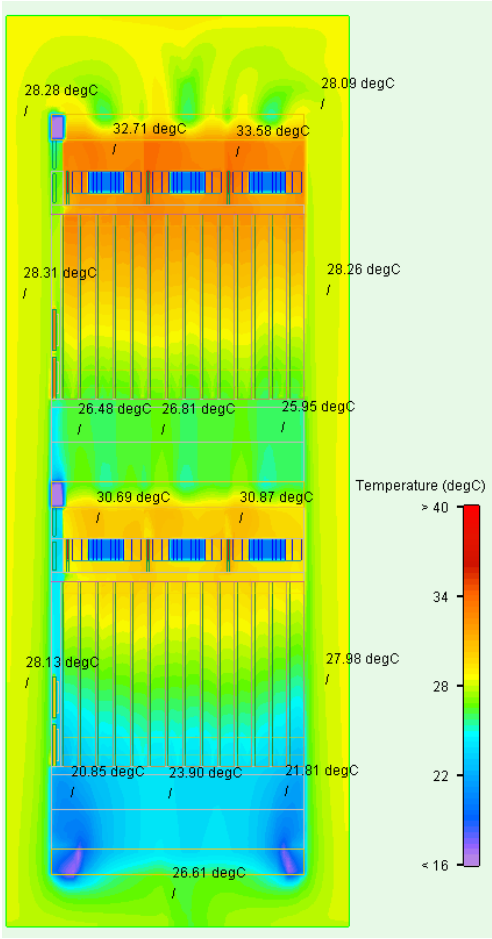
Scenarios, first results and recommendations

3. No turbine chassis simulation run

- MAX TEMP at Hot spots (FAN outlets of to chassis) is 33.5C.
- Delta T inside the chassis is ~10C.

- Turbine bottleneck is removed.
- Maximum air speed is now reduced to 16 m/s
- Next bottleneck at the bottom deflector where some air turbulences provoke less efficient airflow on the bottom shelf side slots





Air Flow Speed results

Scenarios, first results and recommendations

Recommendations

- The turbine blowers deliver less air flow than certain ATCA fan trays.
- In racks where important ATCA blade dissipation is foreseen, the turbine chassis shall be removed.
  - If turbine chassis is removed, maximum in-rack air speed is reduced to 16 m/s (reduced noise level)
  - Turbine chassis could be replaced by a standard empty 4U chassis with front and back panels. This empty chassis could then also be made to still house the rack monitoring module.

Next steps

- Get a new run (as run 3) but with a higher deflector (3 or 4U)
  - Goal: minimize the air turbulences at the rack bottom.
- More accurate simulations at ATCA blade level once rack layout is known
- Final simulation report from ASIS

Any question ?