Proposal of a specification for ATCA shelves for experiments at CERN (for phase 1)

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TWEPP-16, 11th meeting of the xTCA interest group

Outline

- Context (reminder)
  - MTCA procurement framework in place
  - ATCA shelf and rack cooling evaluation
- ATCA shelf specification proposal
  - Technical specification key points
  - Status and next steps

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MTCA procurement framework in place

Power module specification

- Output power: 800W
- Input voltage range: -40V to -60V
- Payload power:
  - 12V ± 10%
  - 80W per channel
  - Output voltage stability: ±200 mV
  - Maximum output noise and ripple: 100 mV (pk-pk)
- Management power
  - 3.3V ± 5%

Selection of the NAT DC840 power module

- Output power: 840W
- Compliant (CERN Specs): Yes
- Pros: Efficiency and IPMI compliance

Shelf specification

- Slots:
  - Up to 12 double width/full-size AMCs
  - 2 MCHs
  - 2 PMs (front) and 4 PMs (rear)
  - 6 RTMs
  - 1 JSM
- 2 interchangeable backplanes
  - Custom backplane connections
  - MTCA.4 compliant
- Max. output air temperature 55°C (ambient: 25°C and 80W per slots)
- Vertically cooled (bottom – top airflow)

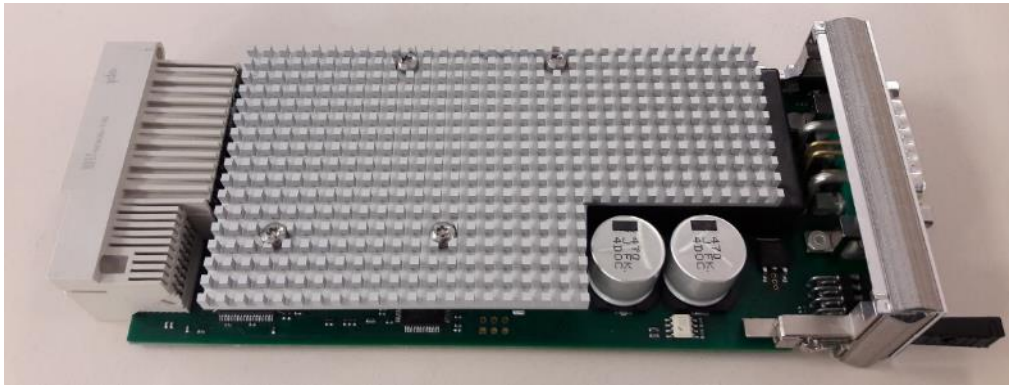
Selection of the Schroff crate

- Compliant (CERN spec): Yes
- Pros: cooling homogeneity, mechanical robustness and remote support

MTCA procurement framework in place

Outcome (power module)

- Most of the results are within the specification
- Qualification process finished successfully
- Qualification report available on request
- Few issues addressed by NAT:
  - Detection of critical temperature (thresholds)
  - Detection of input voltage failure
  - Heat sink



- Purchase framework is established
  - https://espace.cern.ch/ph-dep-ESE-BE-uTCAEvaluationProject/Procurement/_layouts/15/start.aspx#/SitePages/Home.aspx

MTCA procurement framework in place

Outcome (shelf)

- All of the results are within the specification
- Qualification process finished successfully
- Few issues addressed by Schroff:
  - Separated management of front and rear cooling
  - Slot identification
- Recommendations to user:
  - Power module redundancy to be used with care
  - Limitation of the power module to 600W

- Purchase framework is established in 2016
  - https://espace.cern.ch/ph-dep-ESE-BE-uTCAEvaluationProject/Procurement/_layouts/15/start.aspx#/SitePages/Home.aspx

MTCA procurement framework in place

MTCA infrastructure base kit soon available at the electronics pool:

A few sets of MTCA infrastructure equipment will become available for rental in a few weeks:

- Schroff 12 slots Schroff MTCA shelf (custom bkpl topology)
- NAT MCH (base interface, XAUI fat pipe, SFP+ uplink and clk module)
- NAT AC input power module PM-AC600

ATCA shelves evaluated

- Standard commercial shelves (front-to-back airflow)

Schroff 14-slot 13U ATCA

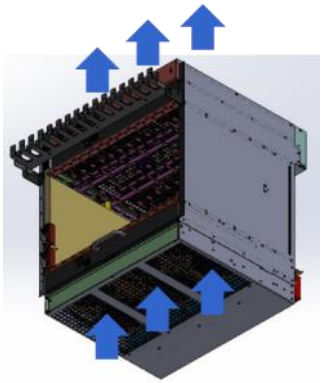
ASIS 14-slot 13U ATCA

Comtel 14 slot

ELMA 14 slot

- ASIS custom shelf (vertical airflow for standard LHC rack)

ASIS custom shelf

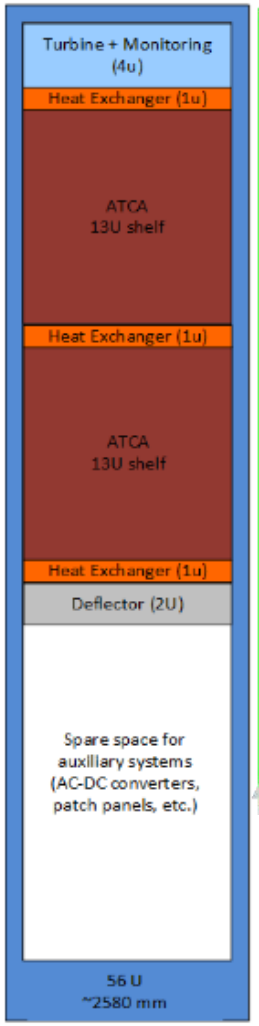


Schroff 2-slot ATCA
11990-705

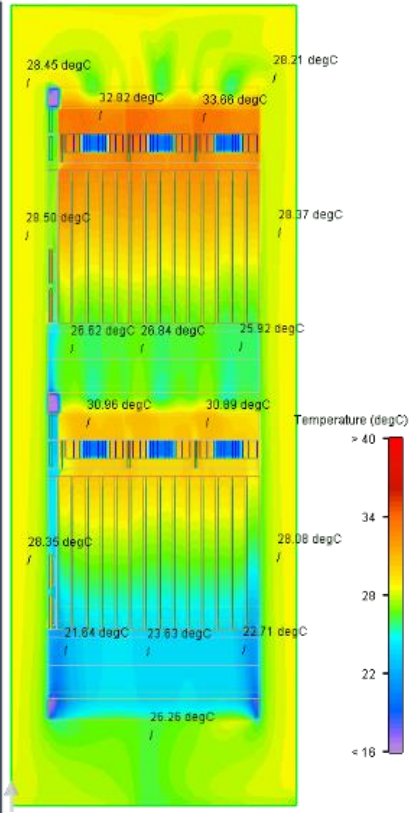
- Evaluation reports available: https://espace.cern.ch/ph-dep-ESE-BE-ATCAEvaluationProject

ATCA shelf and rack cooling evaluation and tests

- Goals:
  - Common specifications for shelves
  - Asses the possibility to re-use existing racks system or specify rack infrastructure for horizontally cooled crates
- AdvancedTCA shelves cooling simulation (CERN rack)
  - Simulations performed (vertical airflow)
  - Some rack improvement has been proposed
  - Simulation report available on request
- AdvancedTCA shelves cooling measurements (CERN rack)
  - ATLAS ATCA cooling evaluation project (C. Bortolin)
  - Measurements performed using vertical and horizontal configurations (using ASIS shelves)



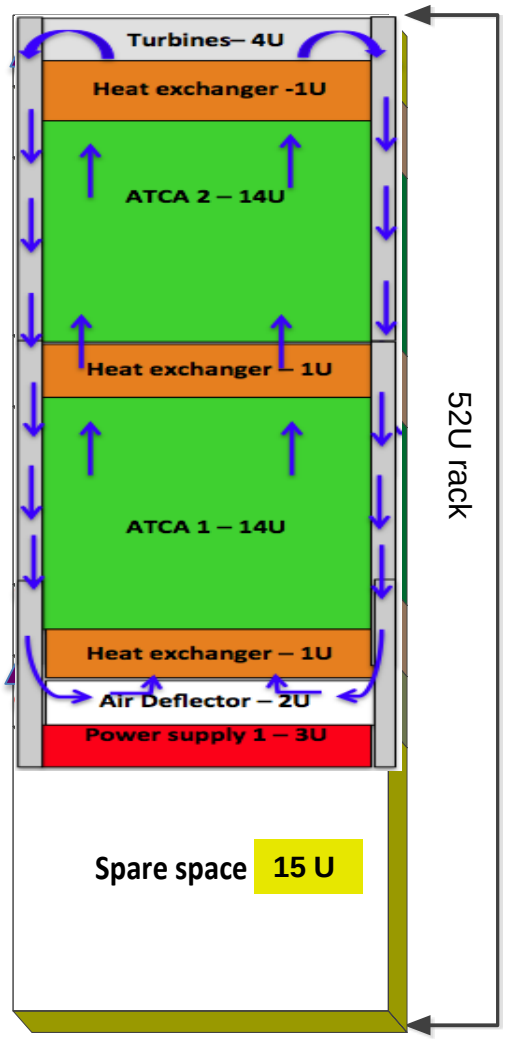
ATCA rack



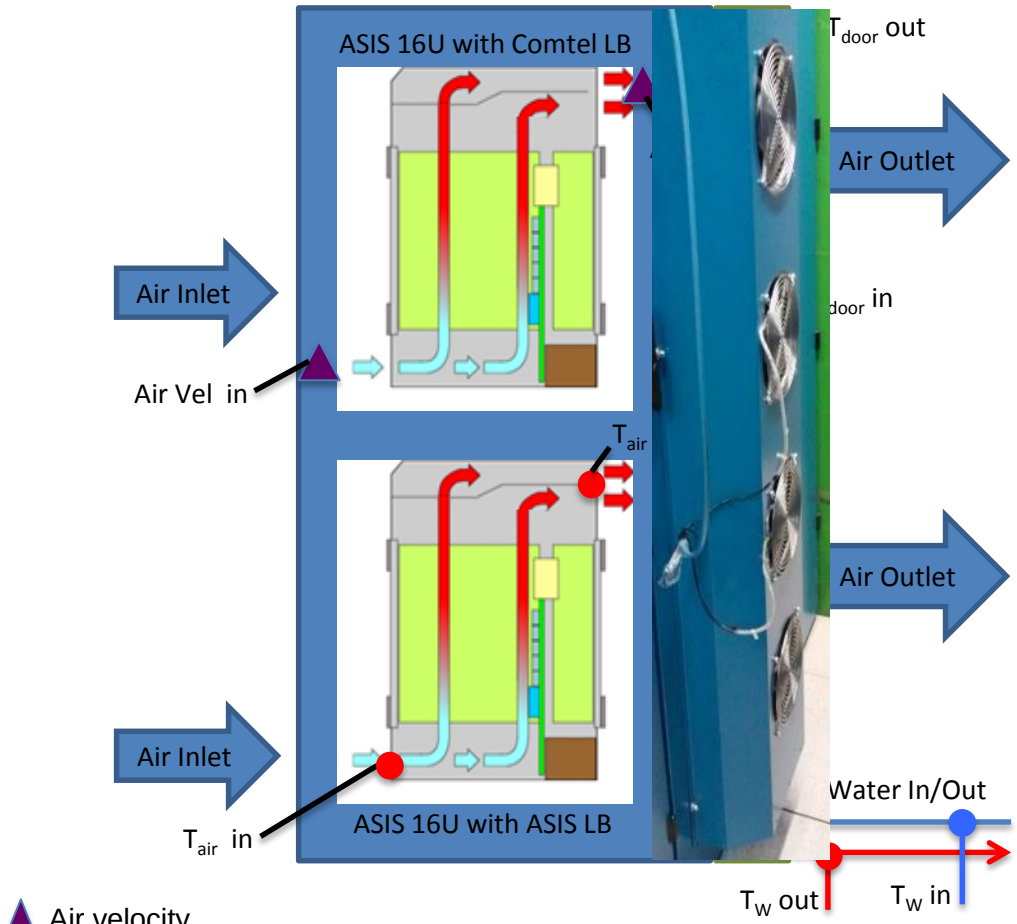
Thermal simulation view

ATCA shelf and rack cooling evaluation and tests

Vertical vs horizontal rack cooling configuration



Vertical rack layout, front view



Horizontal rack layout, side view

ATCA shelf and rack cooling evaluation and tests

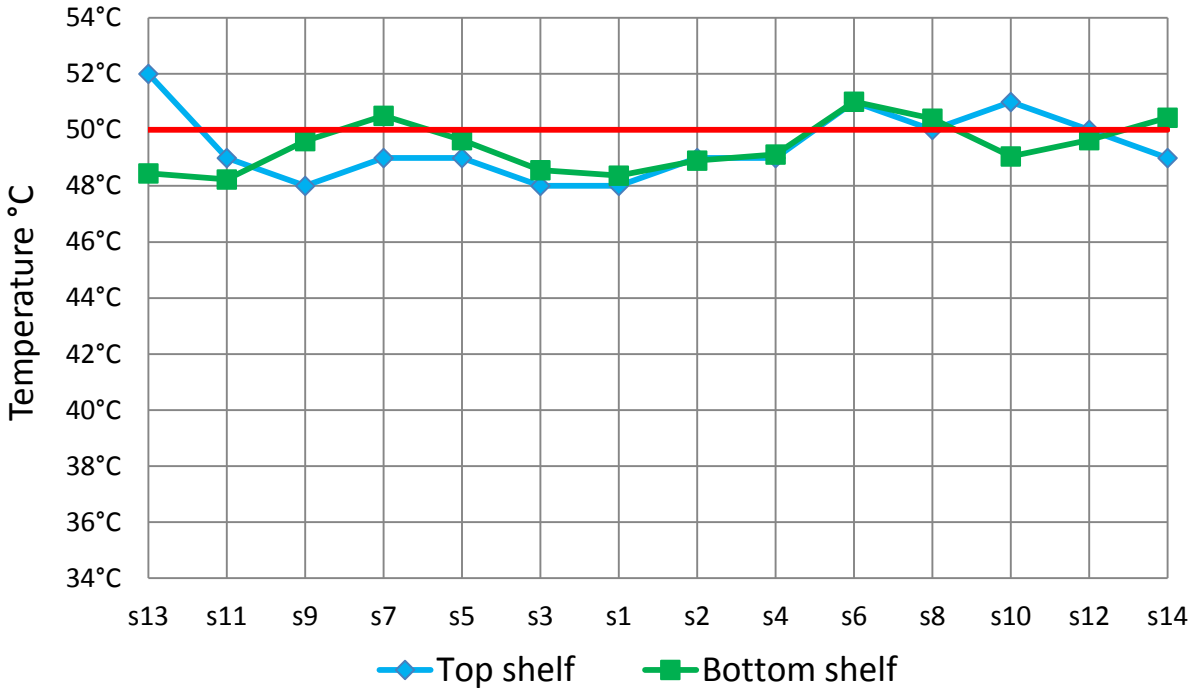
Test results (vertical rack layout, high power test)

Test conditions:

- Bottom (ASIS vert. shelf): 14x400[W] - Asis Load Boards (air temp.)
- Top (ASIS vert. shelf): 14x350 [W] - Comtel Load Boards (blade temp.)
- 4th heat exchanger between both shelves

Average air temperature delta between shelf inlet and outlet [°C]	
Top shelf	Bottom shelf
10.5	9.4

Average of maximal temp. on load blades [°C]	
Top shelf	Bottom shelf
49.4	49.4



ATCA shelf and rack cooling evaluation and tests

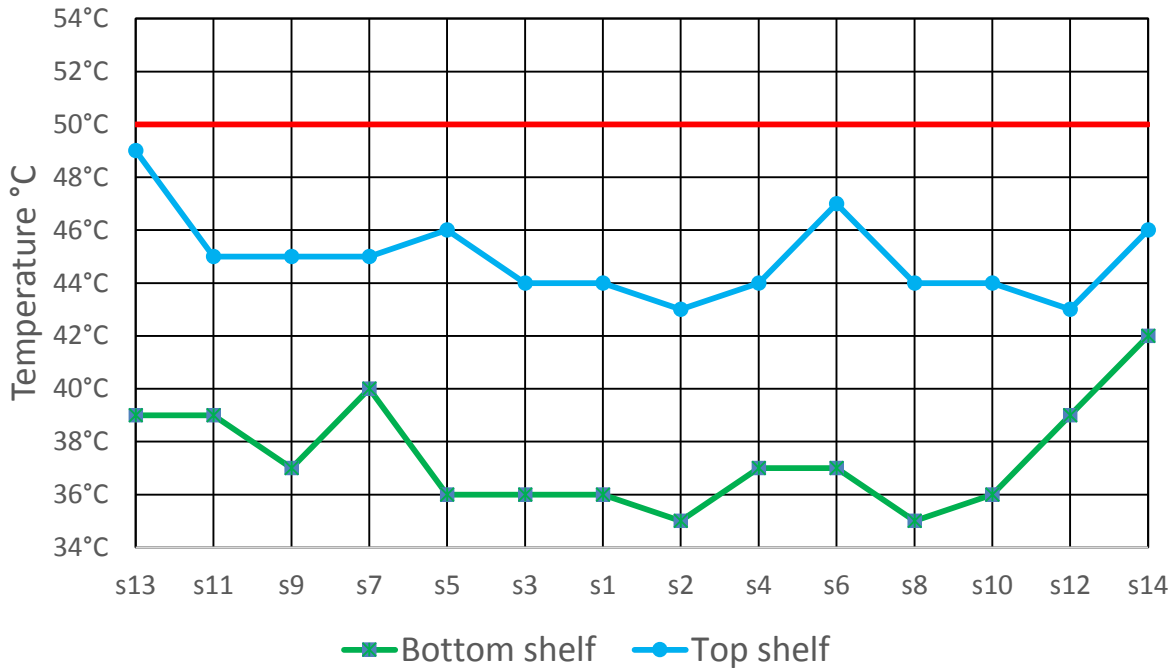
Test results (horizontal rack layout)

Test conditions:

- Bottom (ASIS hori. shelf): 14x350 [W] - Asis Load Boards (air temp.)
- Top (ASIS hori. shelf): 14x350 [W] - Comtel Load Boards (blade temp.)

Average air temperature delta between shelf inlet and outlet [°C]	
Top shelf	Bottom shelf
8.4	9.6

Average of maximal temp. on load blades [°C]	
Top shelf	Bottom shelf
45	37.5



ATCA shelf and rack cooling evaluation and tests

Simulation and measurement summary

Vertical vs horizontal rack cooling airflow

- Simulations and measurements show that both rack layouts can be adopted and are viable for ATCA shelves.
- Vertical rack layout requires some adaptations (adding an heat exchanger, adapting the deflector position).
- With horizontal racks, environmental temperature could become an issue once a room is equipped with many shelves.
- Shelves are noisy (safety measures must be taken: possible sounds barriers, etc.).
- Specific to the used shelves (ASIS): Removing the shelves bottom fans a more homogeneous air flow distribution was observed and the average temperature in the load boards decreases.

This leads to the decision of specifying two variants of ATCA shelves, vertical and horizontal.

Final decision on rack layout must be taken by the experiment (possible important infrastructure implications).

ATLAS ATCA cooling evaluation project final report available here

Outline

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- ATCA shelf specification proposal
  - Technical specification key points
  - Status and next steps

ATCA shelf specification proposal

Technical specification key points (1/2)

Physical shelf baseline:

- 19” rack system compatible card cage
- 14 ATCA blade slots with RTM
- 2 shelf manager slots
- 2 redundant power entry module (PEM) slots (-48Vdc input)
- Removable cable management trays (front and rear)
- Hot-swappable cooling units
- Cooling variants:
  - ❖ Variant 1: Shelf compatible with in-rack vertical air flow
  - ❖ Variant 2: Shelf compatible with PICMG standard front to back air flow
- Shelf maximum height: 14U with variant 1; 16U with variant 2

Backplane requirements:

- Topology 1: Dual star
- Topology 2: Full mesh
- Fabric lane bit rate: 40Gbase-KR4
- Option: 100Gbase-KR4 (for phase 2)

Module location and accessibility:

- Front access:
  - 14 ATCA blades
  - 2 shelf managers
  - Air filter
- Rear access:
  - 14 RTM
  - 2 PEM

Full technical specification available here

ATCA shelf specification proposal

Technical specification key points (2/2)

Other requirements:

Electrical

- Shelf power distribution for minimum: 400W (front blade) + 50W (RTM) to each slot

Shelf manager

- Based on Pigeon Point Systems ShMM700 or newer
- Support the following protocols and interfaces: RMCP, SNMP, SSH
- Support for HPM.1 and HPM.3

Standards, Rules and Regulations:

- PICMG standard:
  - AdvancedTCA base specification PICMG-3.0 Revision-3.0
  - AdvancedTCA base extensions specification PICMG-3.7 Revision-1.0 section 5 for cooling aspects
- Intel specification: IPMI v2.0
- EMC compliance: CISPR22 and CISPR24 Class A and IEC/EN 61000-6-3
- Safety standard: IEC/EN 60950-1 and CERN IS-23 and IS-41
- Ethernet standard: IEEE standard 802.3
- ROHS compliance: WEEE Directive 2012/19/EU
- CE compliance and related regulations

Full technical specification available here

ATCA shelf specification proposal

Status and next steps (1/2)

Status:

- Specification draft submitted to the experiments electronics coordinators.
- Feedback received from the experiments.
  - Specification adapted where appropriate and of common interest.
- Informal market survey carried out with selected manufacturers
  - MS Outcome:
    - All contacted suppliers propose compliant COTS equipment for horizontal airflow.
    - Most of them require development (NRE) for vertical airflow and/or backplane bandwidth (100G) and/or topology (full-mesh).

- *Specification for a modular -48Vdc rectifier system drafted.*

Missing: Quantities and procurement schedule figures from the experiments for phase 1 !

ATCA shelf specification proposal

Status and next steps (2/2)

Next steps:

- Finalize the technical specification with the latest feedback received from the experiments — Q4 2016
- Perform technical evaluation of proposed COTS ATCA chassis from the suppliers — Q1 2017
- Launch an official CERN price enquiry — Q1 2017

	Horizontal	*Vertical*
• Final qualification of 3 pre-series units	Q2 2017	Q2-Q3 2017
• Once approved, setup procurement contract	Q3 2017	Q3-Q4 2017

- *Follow the same path for the -48Vdc rectifier system*

Missing: Quantities and procurement schedule figures from the experiments for phase 1 !

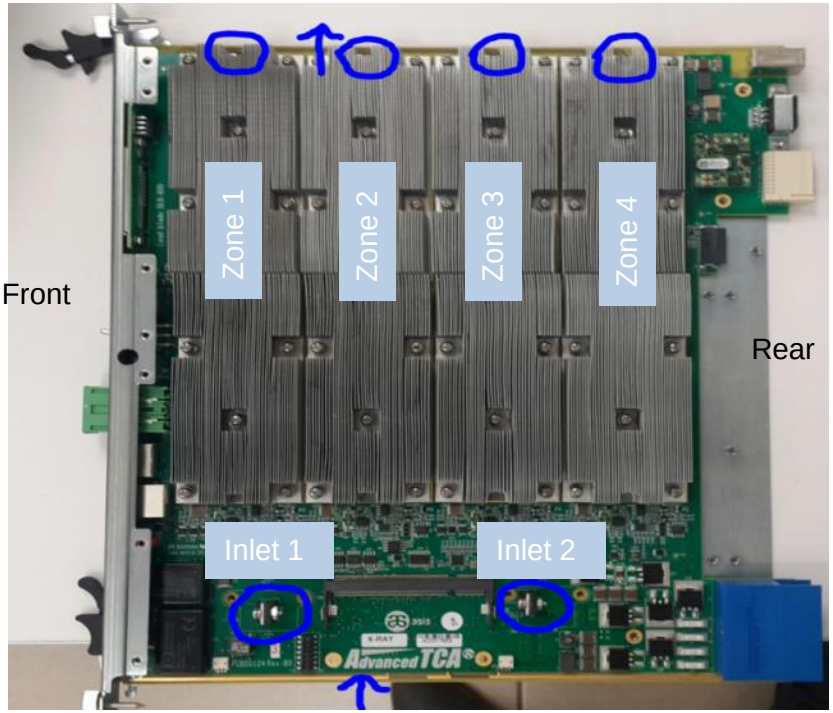
Questions

Backup slides

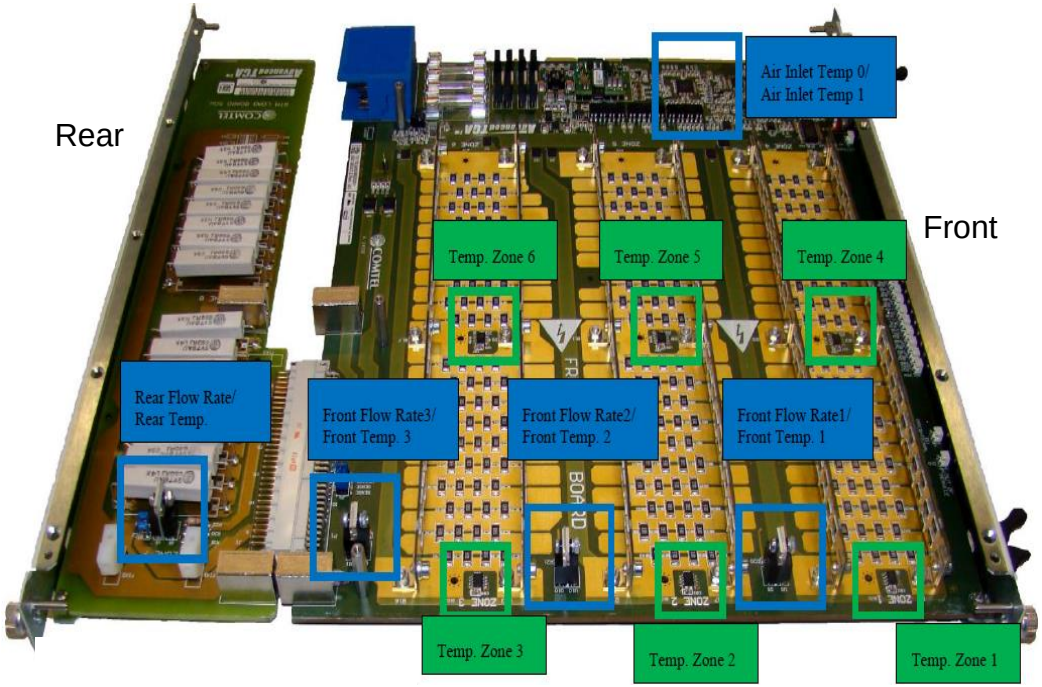
ATCA shelf and rack cooling evaluation and tests

Load blades

ASIS load blades: maximum power 600W



Comtel load blades: maximum power 350W



14 x Comtel blades: 6 Embedded Temperature sensors (green) + 6 air T sensors (blue)

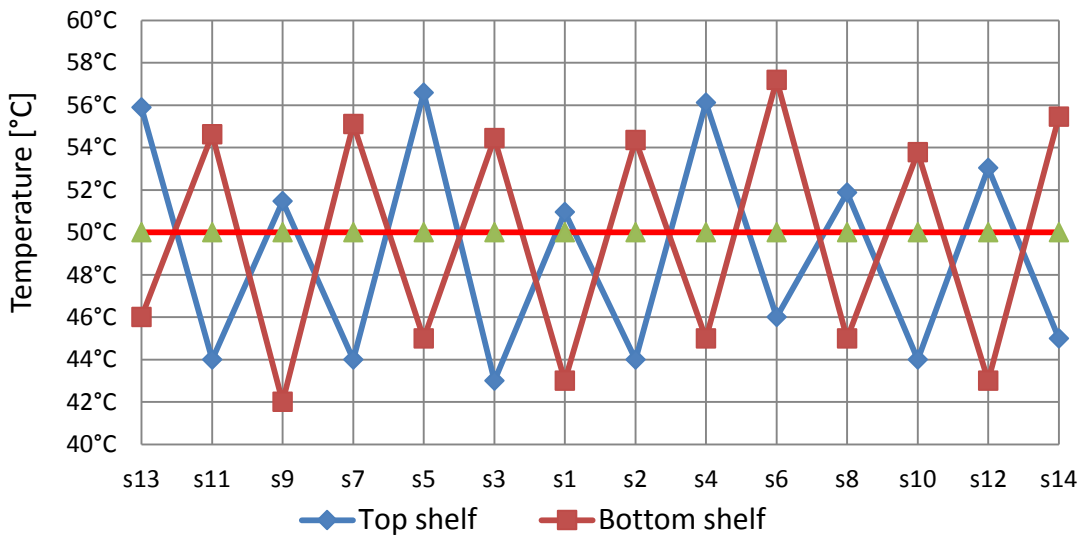
14 x ASIS blades: 6 air Temperature sensors (inlet and outlet)

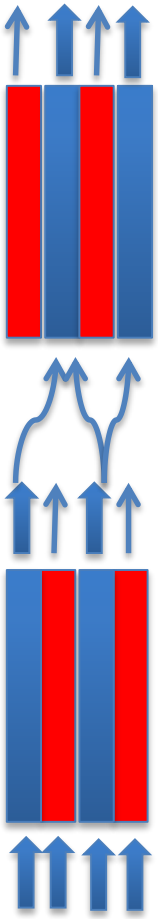
ATCA shelf and rack cooling evaluation and tests

Test results (vertical layout, mixed blade test)

Test conditions:

- Bottom shelf: 7x400[W] - Asis Load Boards + 7x350 [W] - Comtel Load Boards
- Top shelf: 7x400[W] - Asis Load Boards + 7x350 [W] - Comtel Load Boards
- 4th heat exchanger between both shelves





ATCA shelf and rack cooling evaluation and tests

Horizontal or vertical cooling?

Horizontal	Vertical
Use of **COTS** xTCA shelves	Custom xTCA shelves mandatory (related NRE costs and potential higher lead-time)
Sufficient cooling capacity available per rack (up to 15kW per cooling door with water inlet at 13C, now we have 16C!)	**Limited heat-exchanger efficiency** (2/3 of surface capacity resulting in 2kW cooling power)
Heat of 48V AC-DC removed by the rack rear cooling door	48V AC-DC converter (horizontally cooled) must be placed outside of vertical airflow (below the deflector and its cooling must rely on the CR AC)
Less damage risk in case of water leak from the heat exchanger	Risk of water dripping on the ATCA electronics
Independent shelf airflow (one shelf could be turned OFF while the other is loaded)	Cross shelf airflow dependency (in case one shelf is stopped the other sees a high airflow resistance). Can lead to potential electronics overheating
Racks to be modified and equipped with rear cooling doors	Reuse of the rack (horizontal heat exchangers and deflectors may have to be repositioned)
In-rack smoke detection must be adapted for rear-cooling doors	Reuse of the existing rack infrastructure (smoke detection, monitoring and control)
Front and back **cabling must be managed appropriately** in order not to obstruct the air inlet and outlet	Free access to both sides of the shelf
Some racks are currently equipped with a full height glass front door. It is not know yet if such doors can be used with horizontal airflow	Racks can be closed with doors
Higher level of noise (~85 dbA @1 m and 75 % fan speed)	Also noisy…. Easier to install sound absorbing material

ATCA shelf specification proposal

Feedback received from the experiments

ATLAS:

- Higher power rating per slot would be useful
- Maximum depth and use of ETMs / EBs (PICMG 3.7)
- Shelf manager HPM.3 support
- Slot labelling: physical or logical numbering?
- Cable trays shall be removable with the shelf is installed in rack
- Is shelf height restriction required? Where does the requirement for pull-only fans come from?

ALICE

- Suggestion: get the specs reviewed by BE-ICS for control aspects

CMS:

- 100Gbps is likely to be required
- Selection process shall include some signal integrity verification
- Power figures are minimum sufficient
- Both backplane topologies (FM and DS) shall be available
- Suggestion: steer suppliers towards the use of latest generation of ADF connector for zone 2.

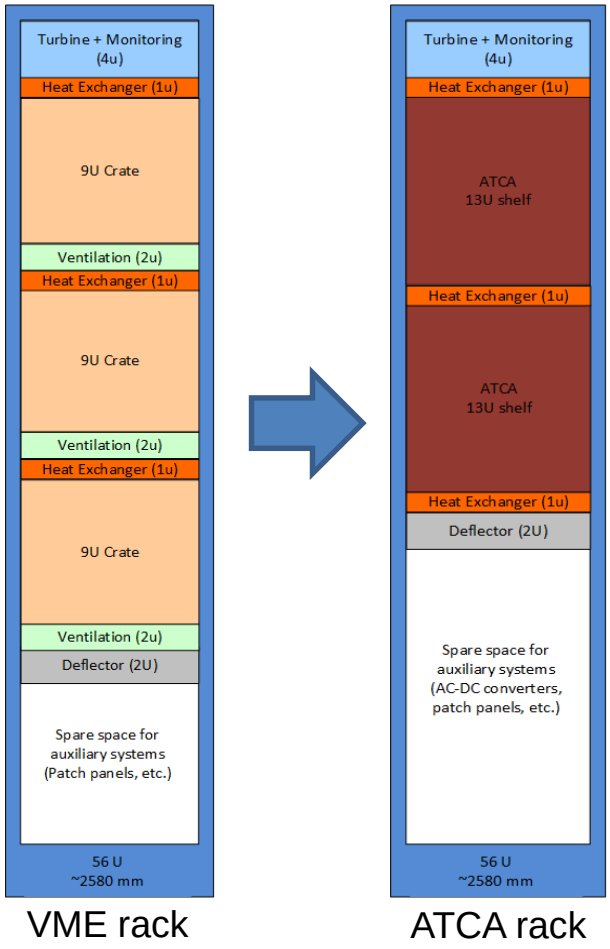
- Preferences:
  - Dual star
  - Vertical airflow
  - Total height: the lower the better

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

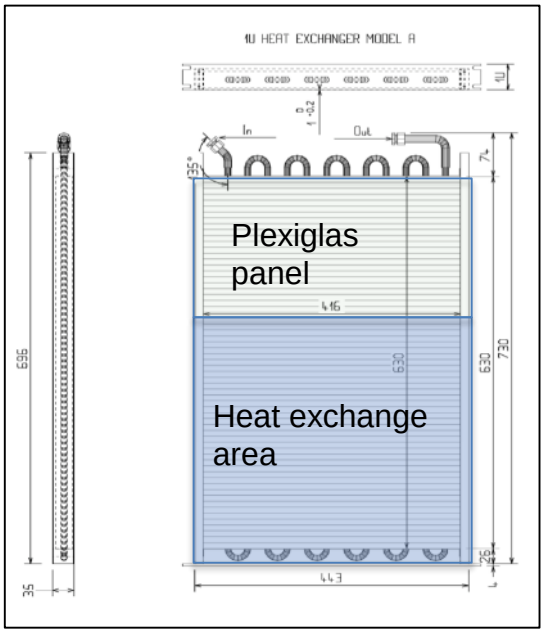


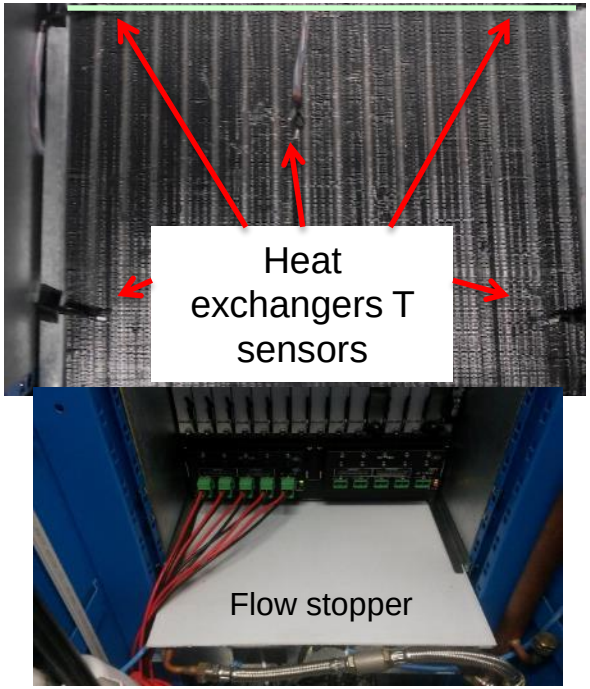
ATCA shelf and rack cooling evaluation and tests

Vertical cooling configuration

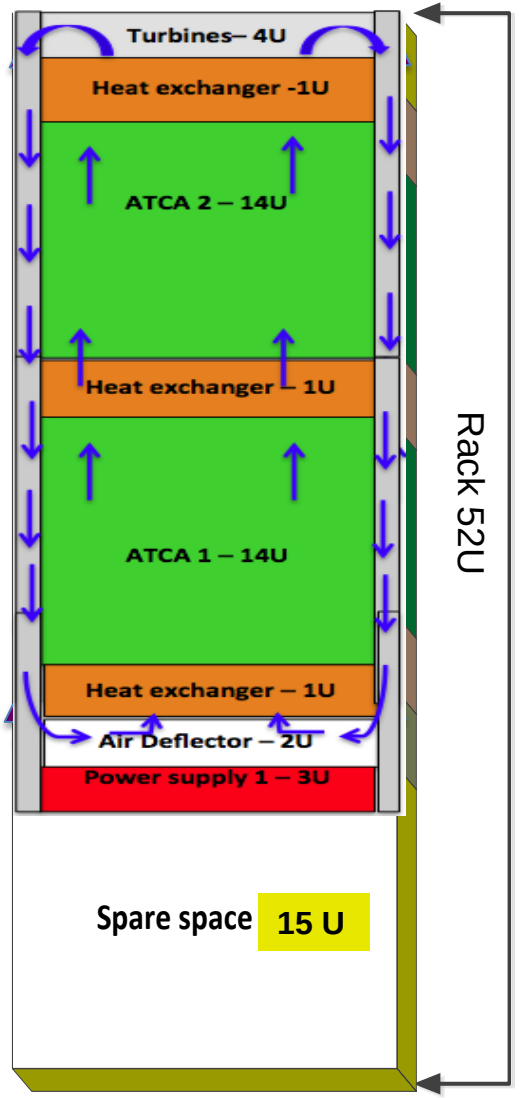
30 x Temperature sensors (accuracy 0.1C)

8 x Velocity sensors (accuracy 0.05 m/s)





Back view of the heat exchanger

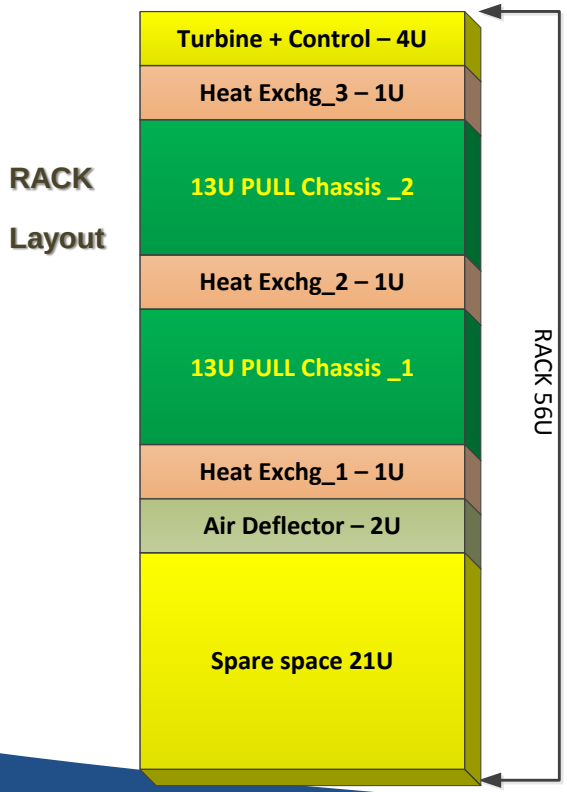


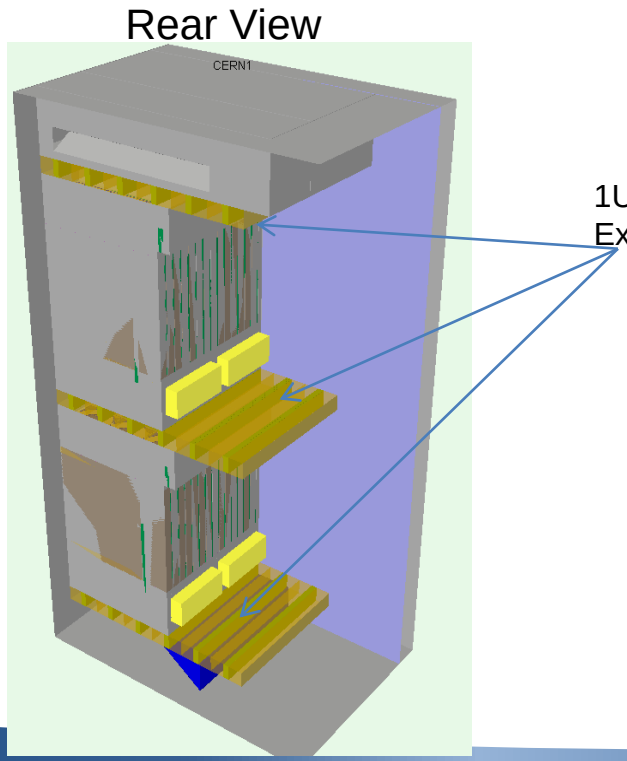
- Air/water heat exchangers (1U), providing up to 3.8 kW of thermal capacity each
- Exchanged surface reduced (approx. 2/3)
- Plexiglas panel installed to improve the leak tightness

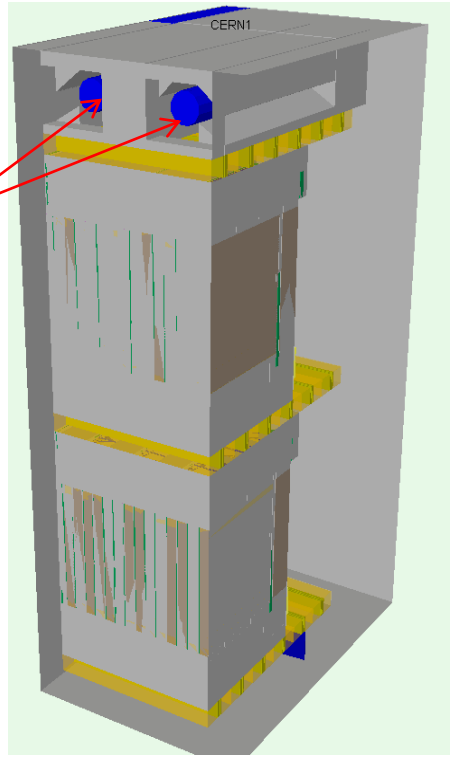
Scenarios, first results and recommendations

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





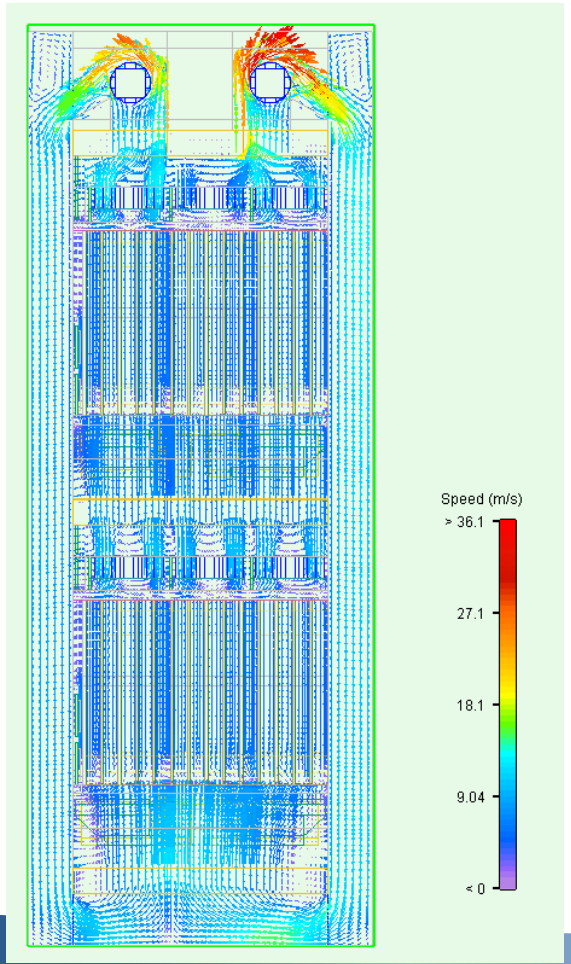


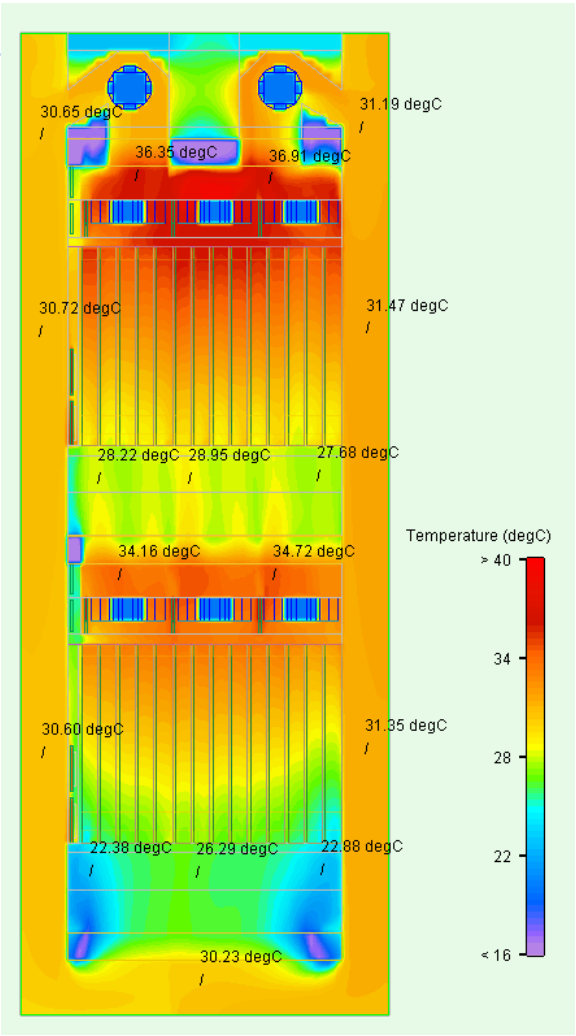
Scenarios, first results and recommendations

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





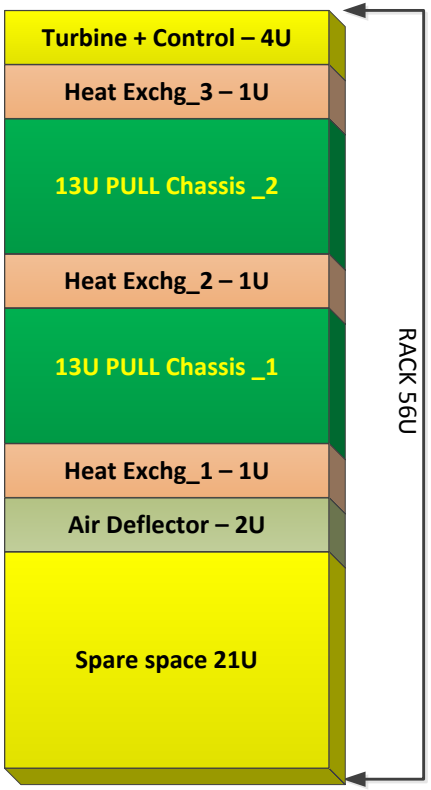
Air Flow Speed results

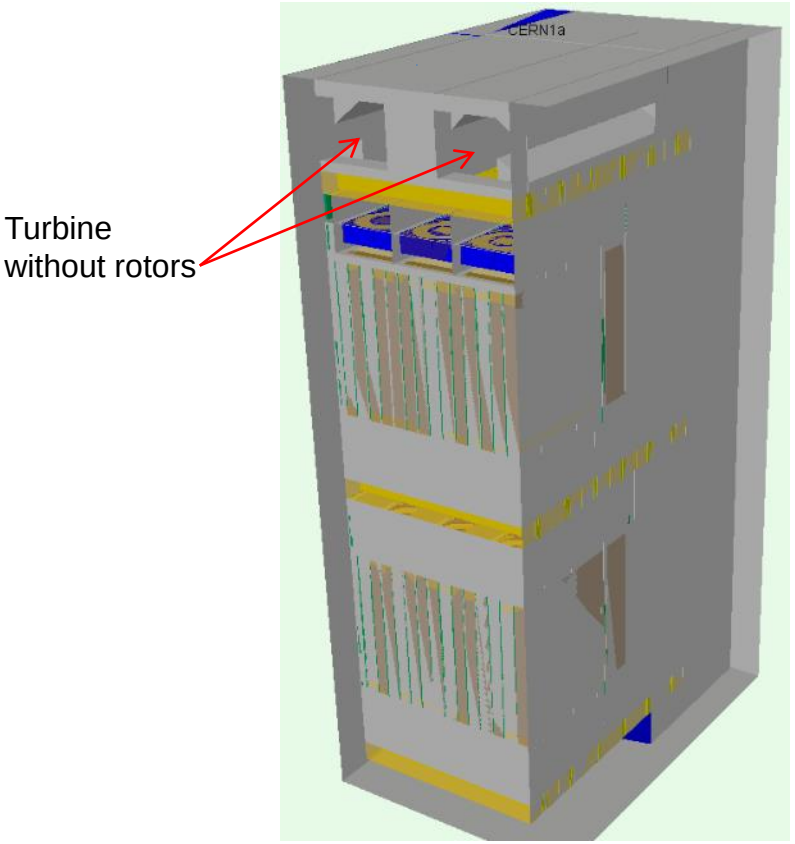
Scenarios, first results and recommendations

2. No turbine rotor simulation run

- Other conditions as in run 1

RACK Layout



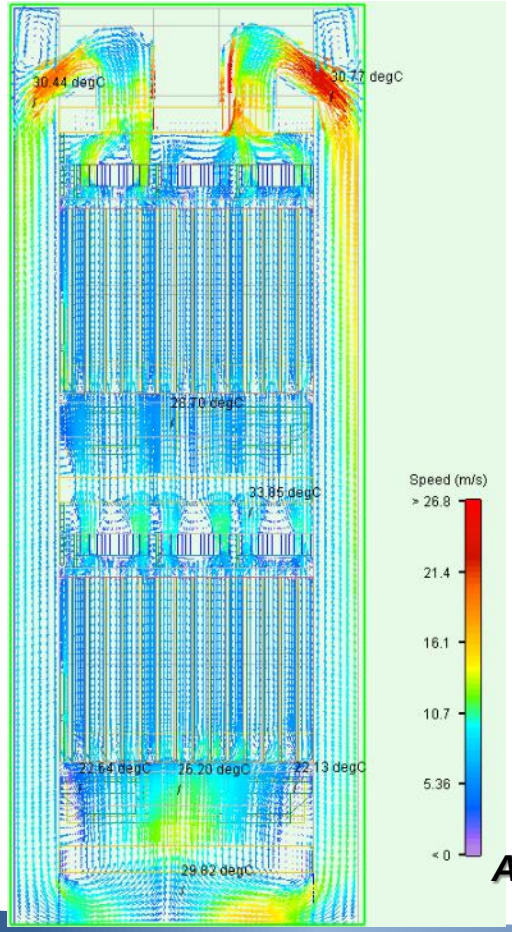


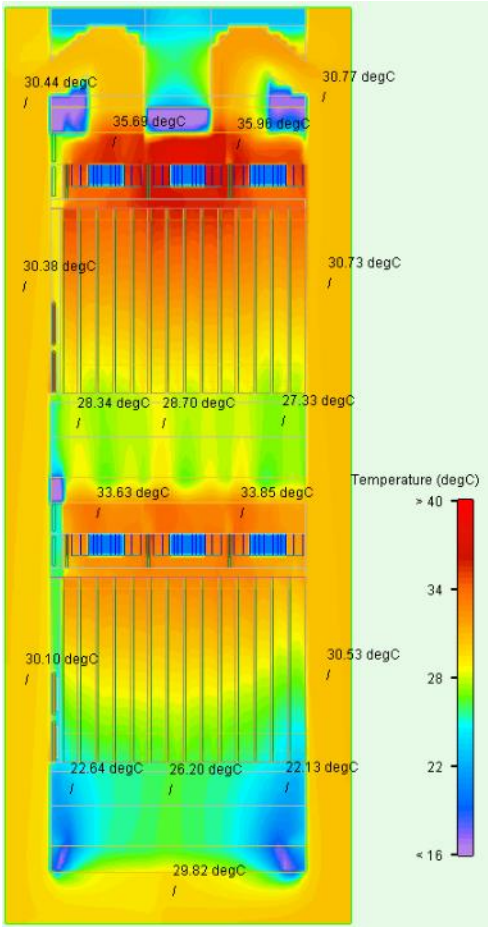
Scenarios, first results and recommendations

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.





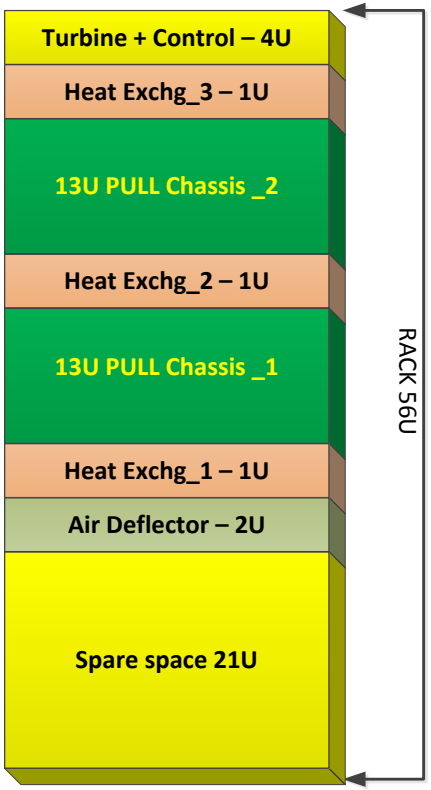
Air Flow Speed results

Scenarios, first results and recommendations

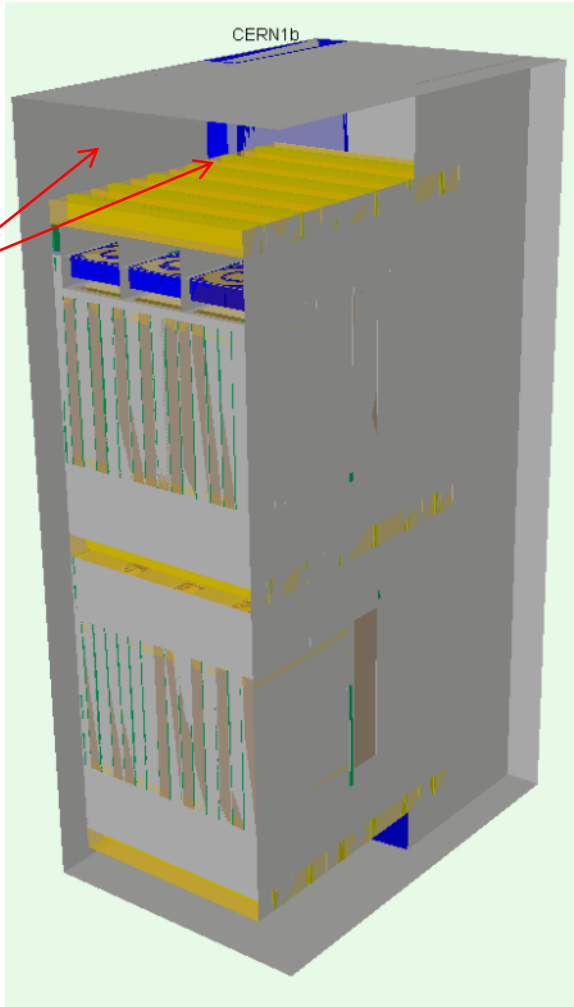
3. No turbine chassis simulation run

- Other conditions as in run 1

RACK Layout



Turbine is removed entirely

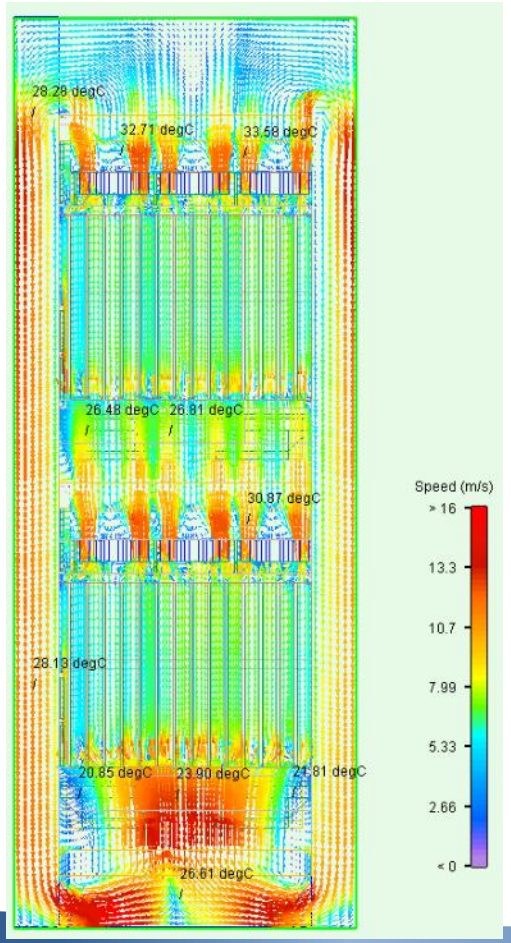


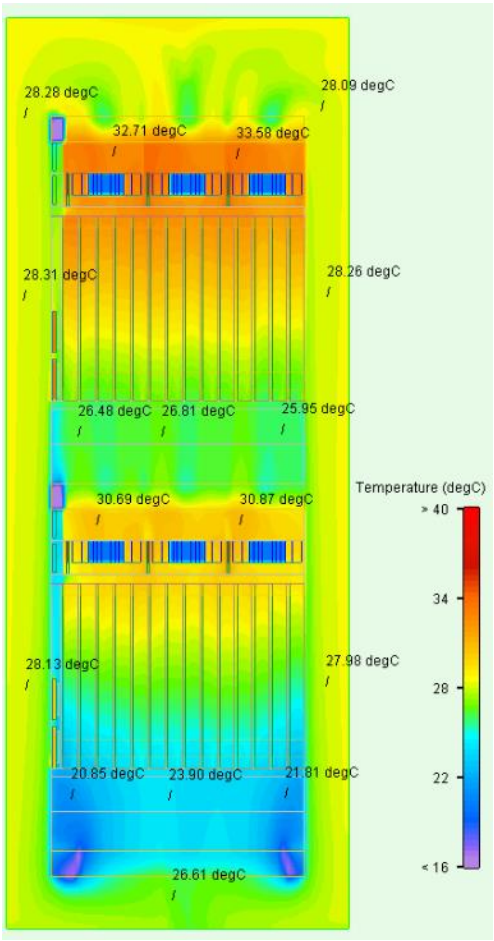
Scenarios, first results and recommendations

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

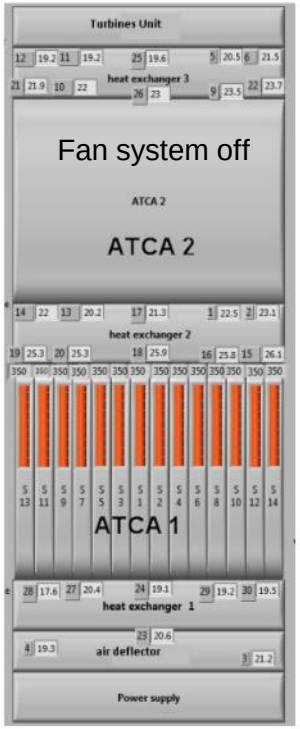
- The turbine blowers deliver less air flow than certain ATCA fan trays.
- In racks where important ATCA blade dissipation is foreseen, the turbine chassis shall be removed.
  - If turbine chassis is removed, maximum in-rack air speed is reduced to 16 m/s (reduced noise level)
  - Turbine chassis could 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

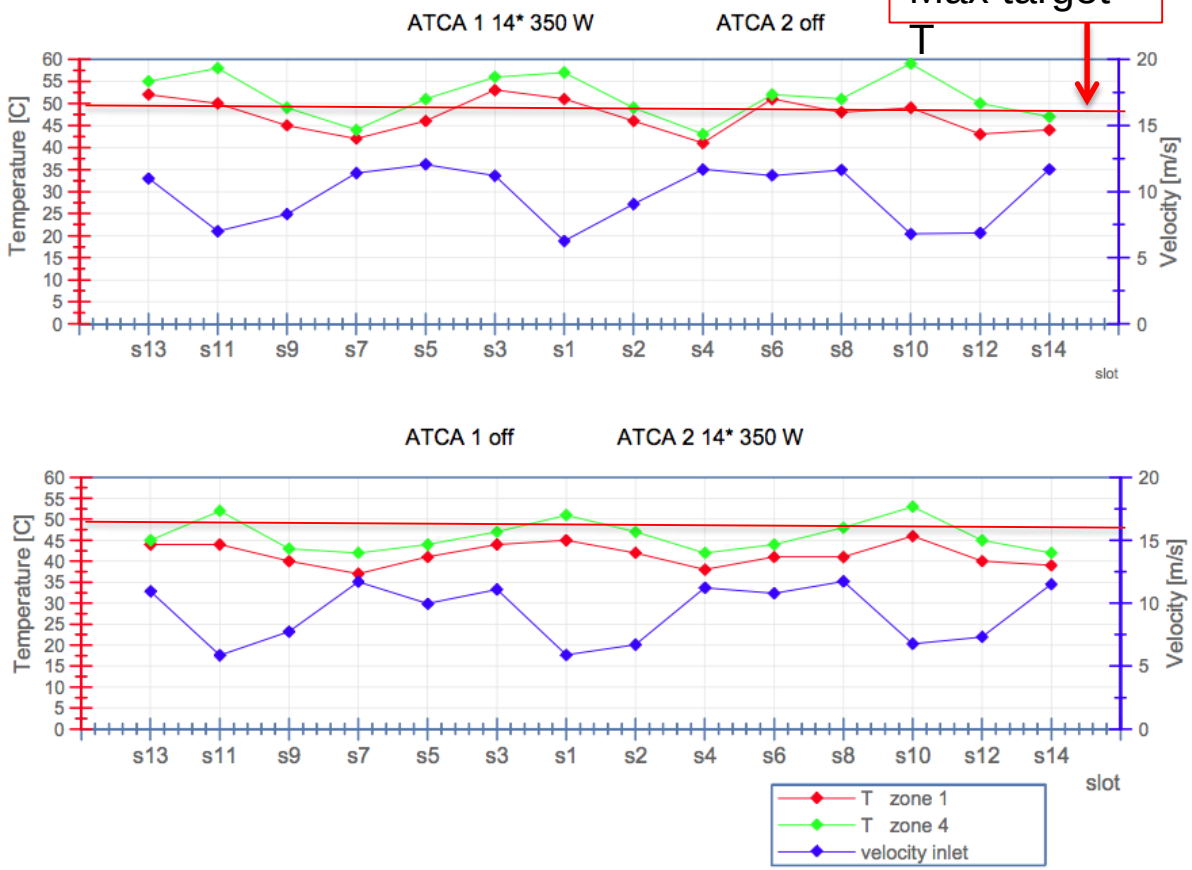
- Get a new run (as run 3) but with a higher deflector (3 or 4U)
  - Goal: minimize the air turbulences at the rack bottom.
- More accurate simulations at ATCA blade level once rack layout is known
- Final simulation report from ASIS

Failure mode: full power only in one crate

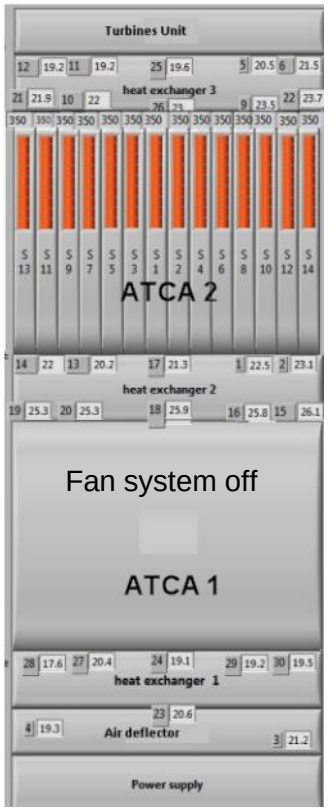
ATCA 1 14* 350 W
ATCA 2 0 W



with rack turbines



ATCA 1 0 W
ATCA 2 14* 350 W



Mixed water data taken while ATCA 1 was fully powered

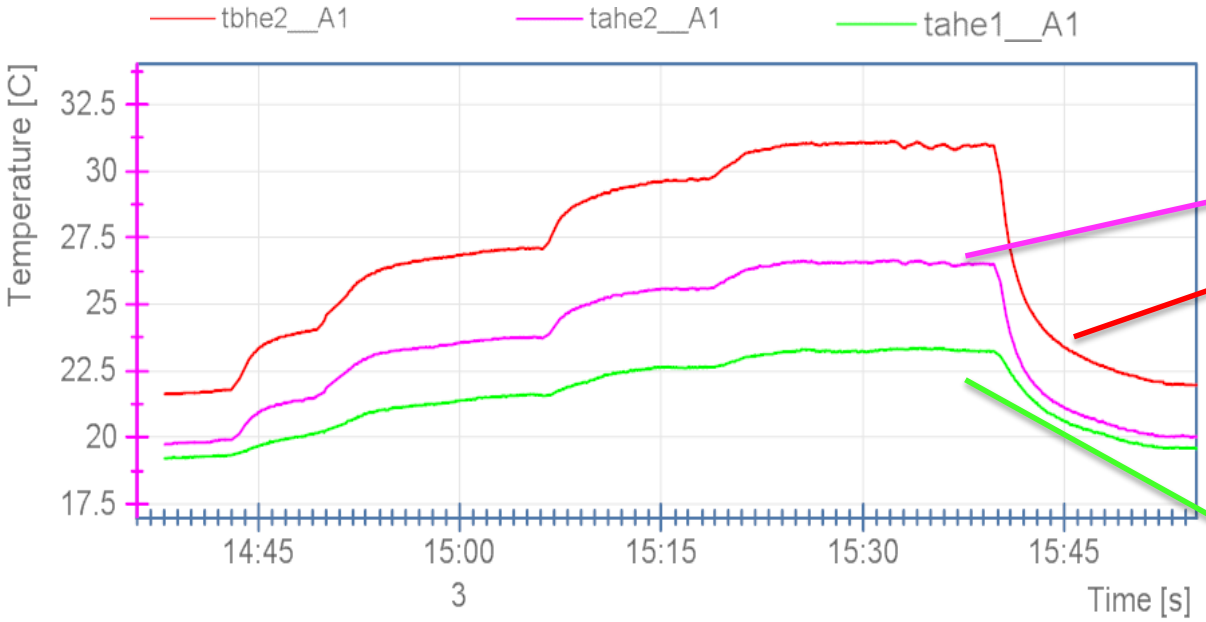
- Flow: 0.8 m^3/h
- T inlet 15.5C, T outlet 20.9C

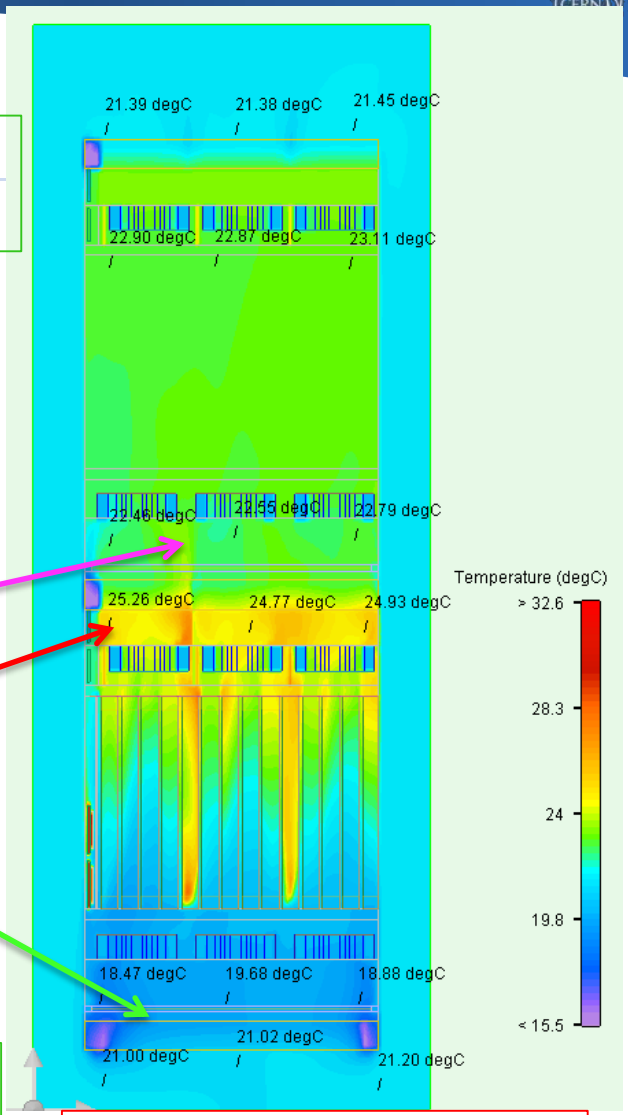
$Q = mC_p (T_{out} - T_{in}) = 0.22 \times 4.18 \times (20.9 - 15.5) =$

$= \mathbf{5.01\ kW}$

Air Temperatures

The plot shows the average temperatures measured on the air deflector, before and after HX1 with only ATCA 1 full power



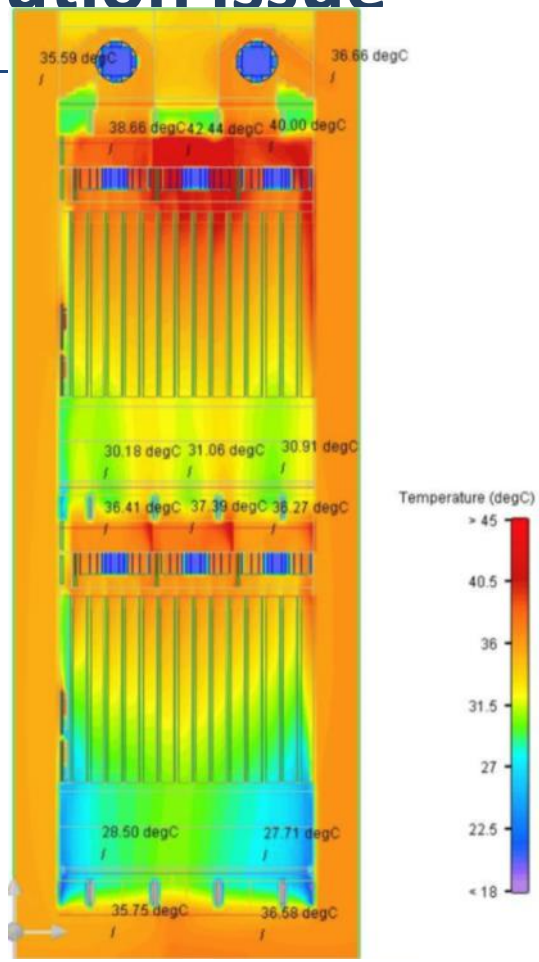


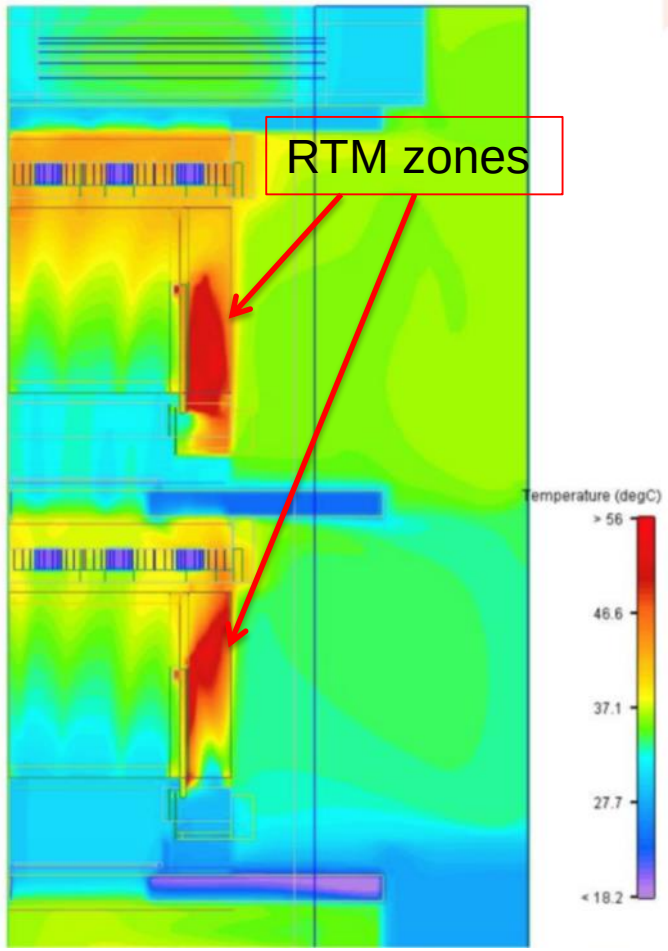
Air temperatures comparison shows that the simulation reproduced lower T, the difference was about 5C.

Simulations carried out by ASIS with the same configuration

ASIS run new simulations using our measurements as input data. It was identify a general lack of performance of the 25% (i.e.: leaks). Further simulations identify another issue.

Flow distribution issue





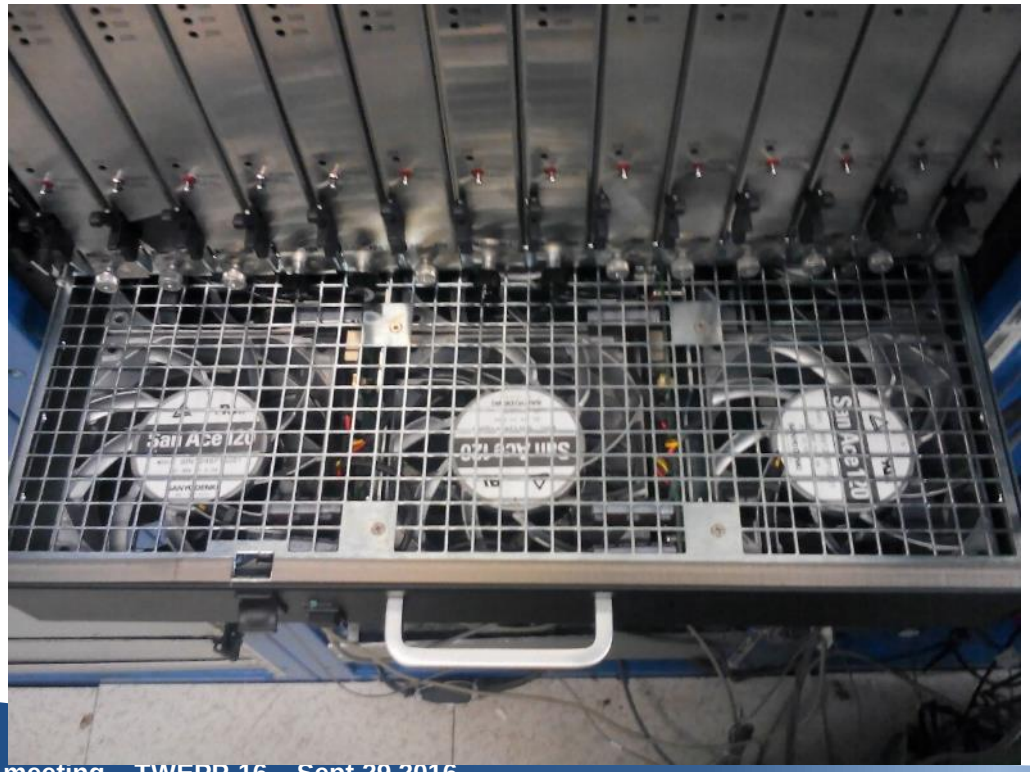
ASIS comments:

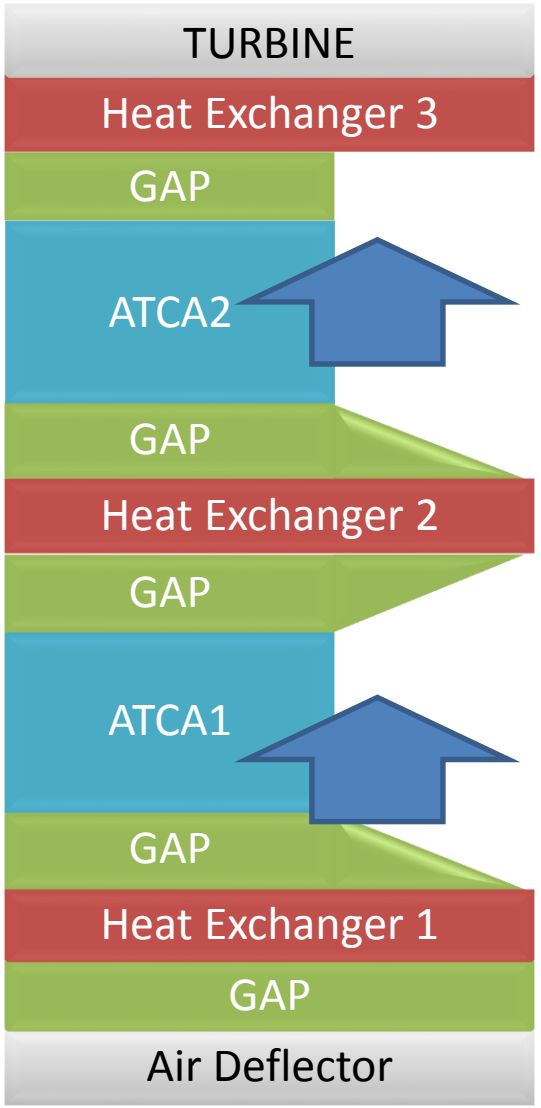
1) In order to improve the flow instability on the RTM side try to remove the bottom fan tray and rely only on the pull flow.
2) Introducing gaps between heat exchangers and try to improve the whole heat exchangers surface.

New layout (October 2015)

In the RTM volume the flow circulation was not effective and the suggestions of ASIS were:

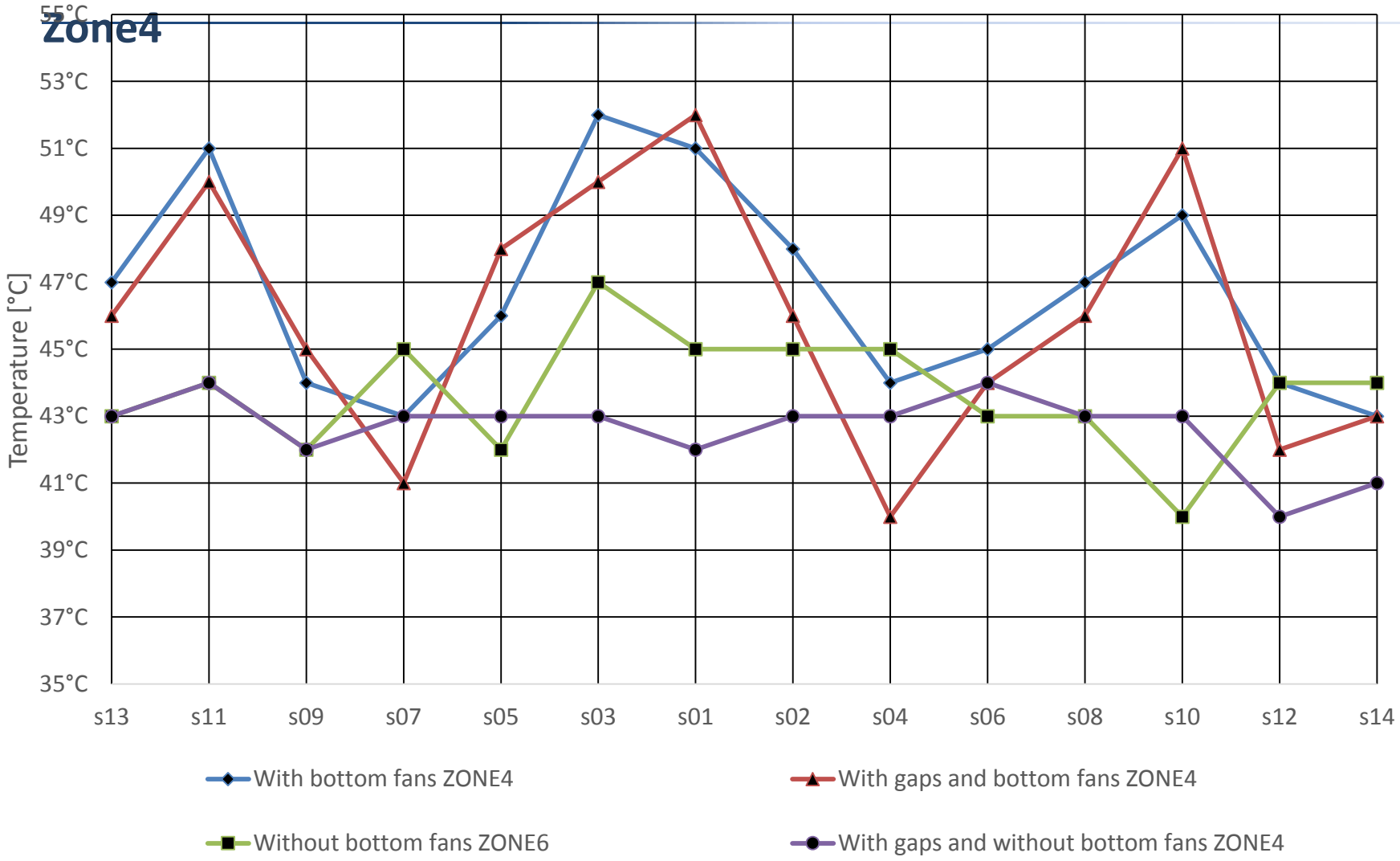
1) To remove the chassis bottom fans
2) To Introduce some gaps before and after each heat exchanger





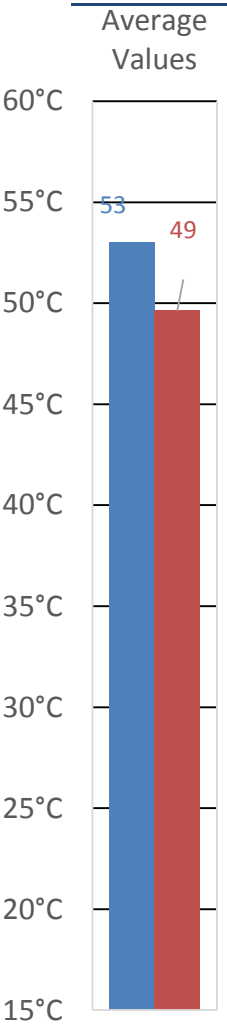
ATCA 1 All ON and ATCA 2 ONLY FANS

Zone4



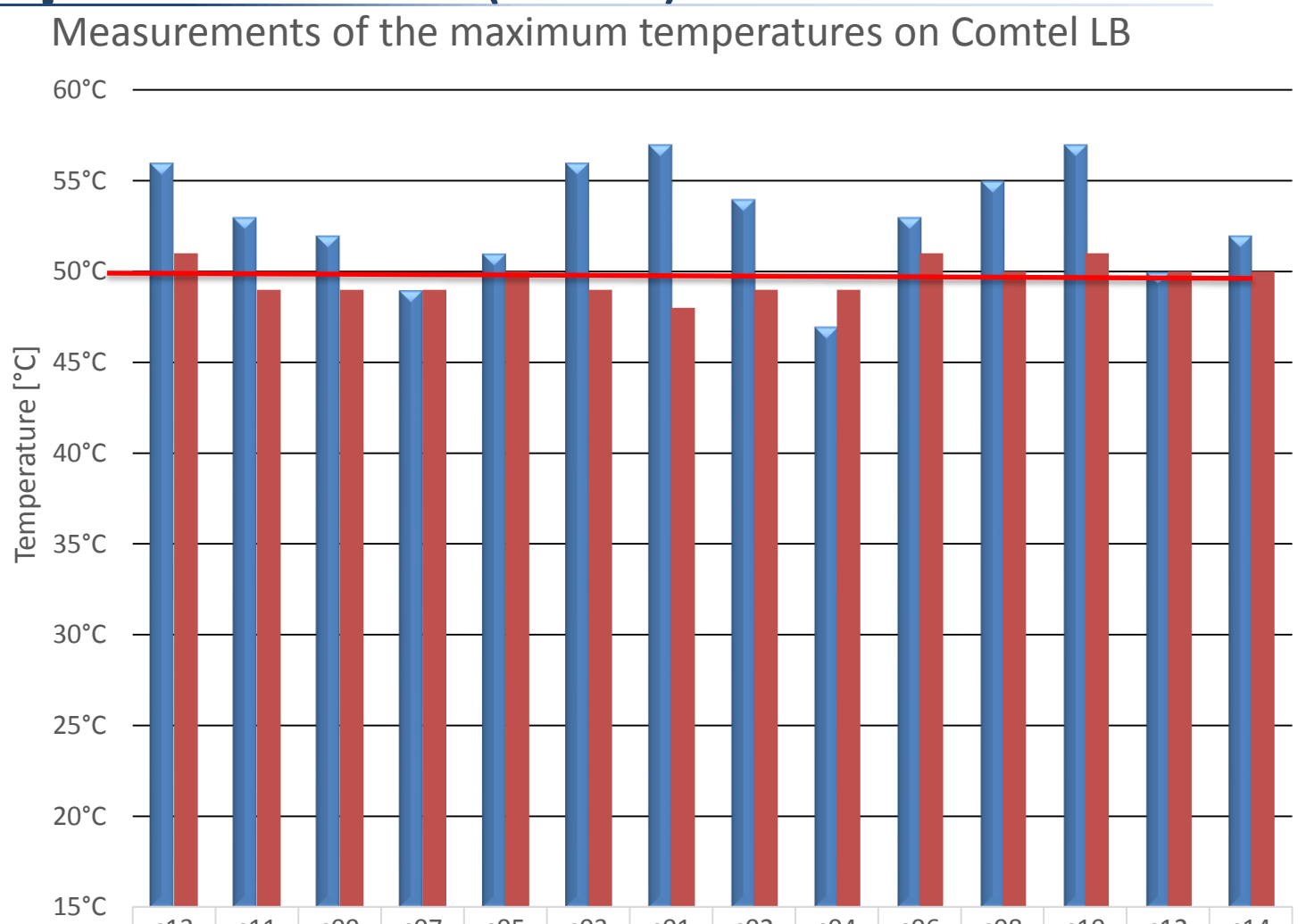
Removing bottom fans improved significantly the performance: flow distribution more homogeneous.

ATCA2 14x343[W] – Comtel Load Boards (Top)
ATCA1 14x322[W] – Asis Load Boards (Bottom)



With Bottom Fans

Without Bottom Fans

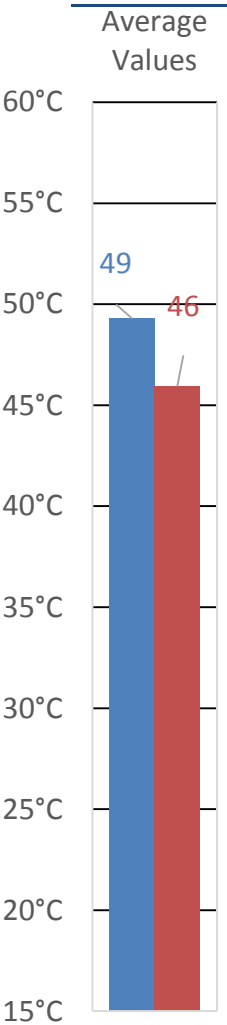


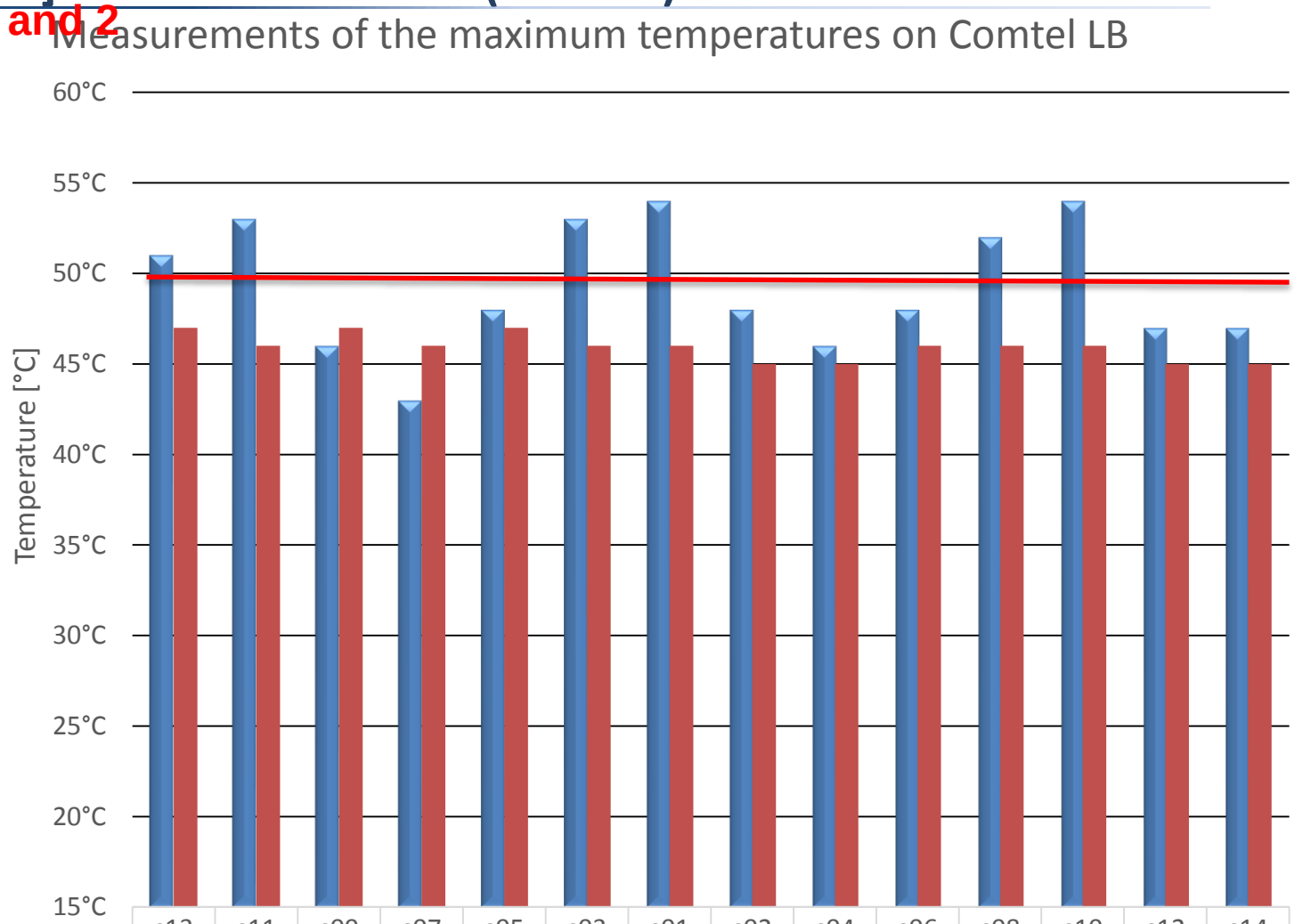
	s13	s11	s09	s07	s05	s03	s01	s02	s04	s06	s08	s10	s12	s14
Zone 4	56	53	52	49	51	56	57	54	47	53	55	57	50	52
Zone 4 WOUTBF	51	49	49	49	50	49	48	49	49	51	50	51	50	50

Max power limited by the a smaller power supply of the top shelf

ATCA2 14x343[W] – Comtel Load Boards (Top)
ATCA1 14x322[W] – Asis Load Boards (Bottom)

4th heat exchangers added between ATCA 1 and 2





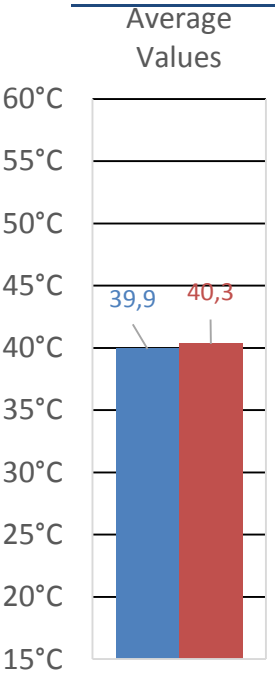
	s13	s11	s09	s07	s05	s03	s01	s02	s04	s06	s08	s10	s12	s14
Zone 4	51	53	46	43	48	53	54	48	46	48	52	54	47	47
Zone 4 WOUTBF	47	46	47	46	47	46	46	45	45	46	46	46	45	45

With Bottom Fans

Without Bottom Fans

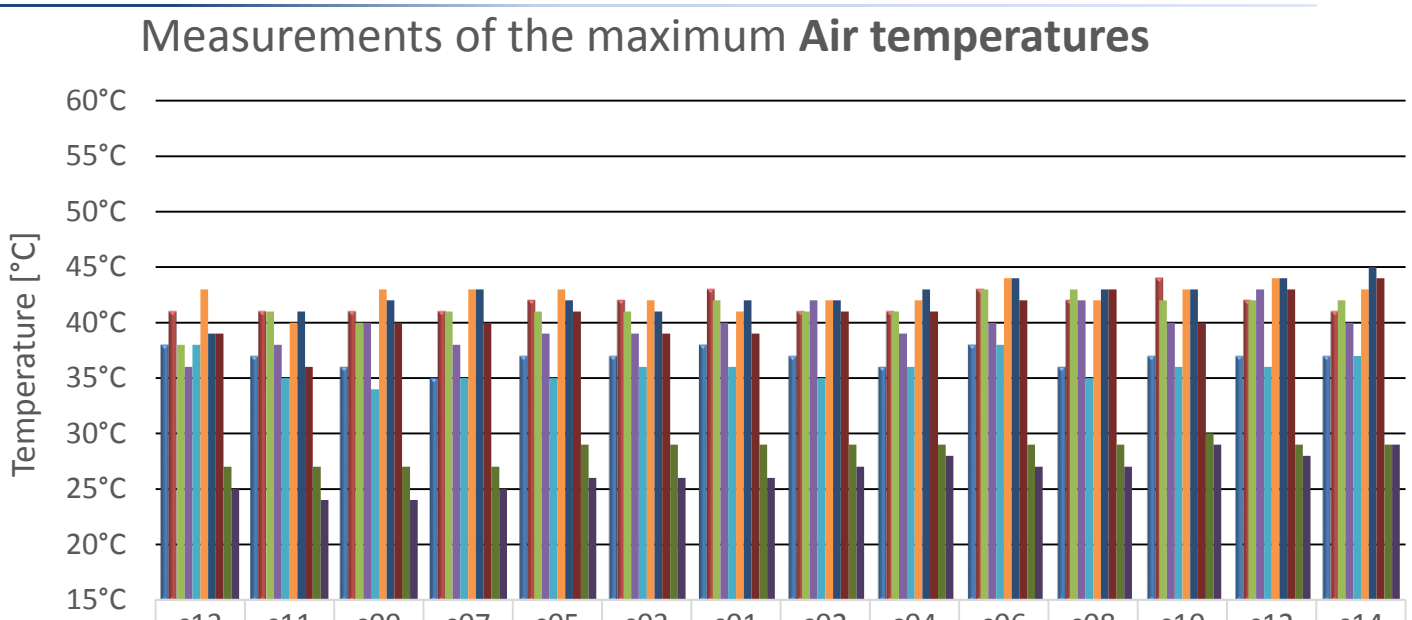
The average T decreased of 3-4 degrees

ATCA2 14x343[W] – Comtel Load Boards (Top)
ATCA1 14x322[W] – Asis Load Boards (Bottom)



With Bottom Fans

Without Bottom Fans



	s13	s11	s09	s07	s05	s03	s01	s02	s04	s06	s08	s10	s12	s14
Zone 1	38	37	36	35	37	37	38	37	36	38	36	37	37	37
Zone 2	41	41	41	41	42	42	43	41	41	43	42	44	42	41
Zone 3	38	41	40	41	41	41	42	41	41	43	43	42	42	42
Zone 4	36	38	40	38	39	39	40	42	39	40	42	40	43	40
Zone 1 WOUTBF	38	35	34	35	35	36	36	35	36	38	35	36	36	37
Zone 2 WOUTBF	43	40	43	43	43	42	41	42	42	44	42	43	44	43
Zone 3 WOUTBF	39	41	42	43	42	41	42	42	43	44	43	43	44	45
Zone 4 WOUTBF	39	36	40	40	41	39	39	41	41	42	43	40	43	44
Inlet 1	27	27	27	27	29	29	29	29	29	29	29	30	29	29
Inlet WOUTBF	25	24	24	25	26	26	26	27	28	27	27	29	28	29

Air T increased without bottom fans: more effective heating removal

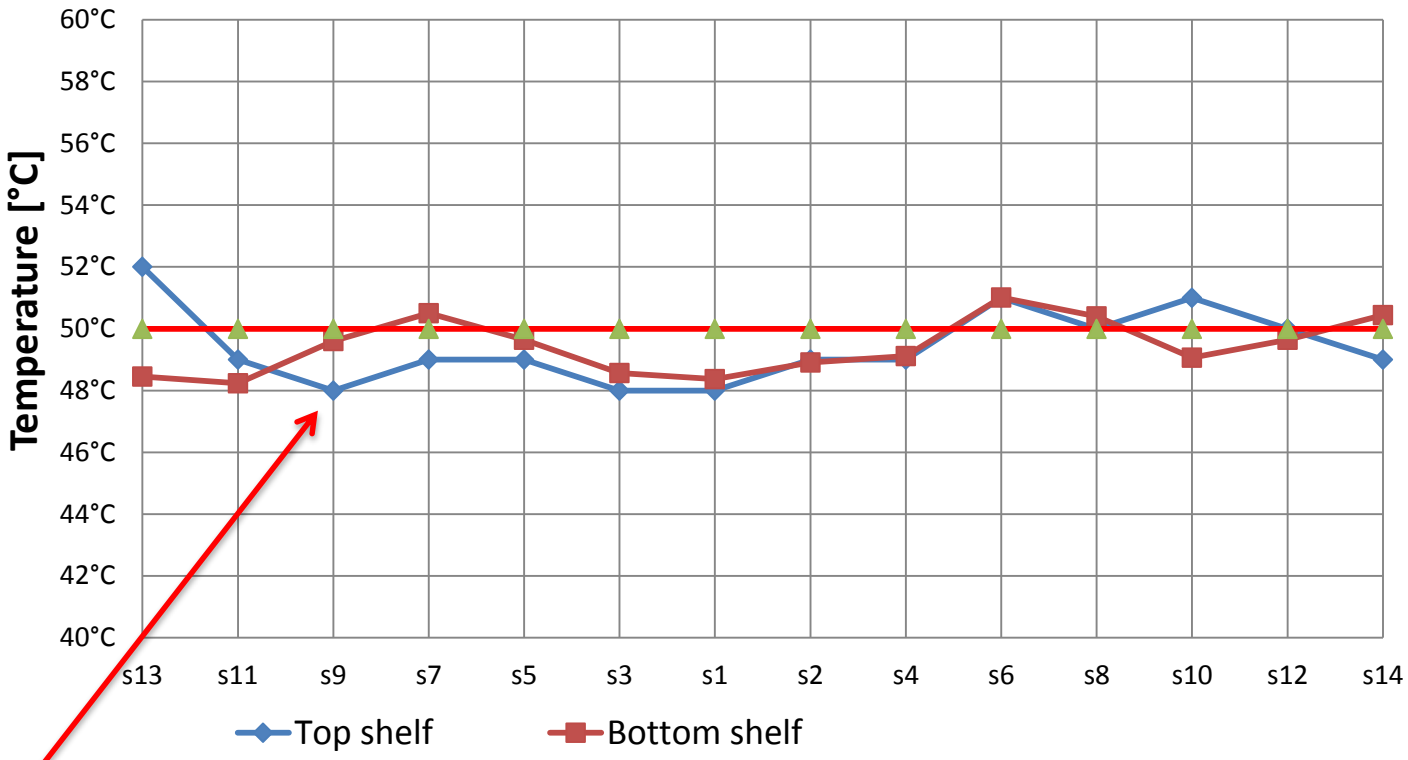
High power test

ATCA2 13x350 [W] slot 9 at 336[W] – Comtel Load Boards (Top)

~~ATCA1 14x400[W] – Asis Load Boards (Bottom)~~

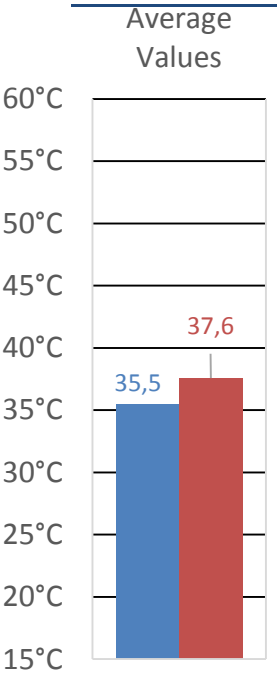
4th heat exchanger between ATCA 1 and 2

Averege maximal temperature on load blades [°C]	
Top shelf	Bottom shelf
49.4	49.4



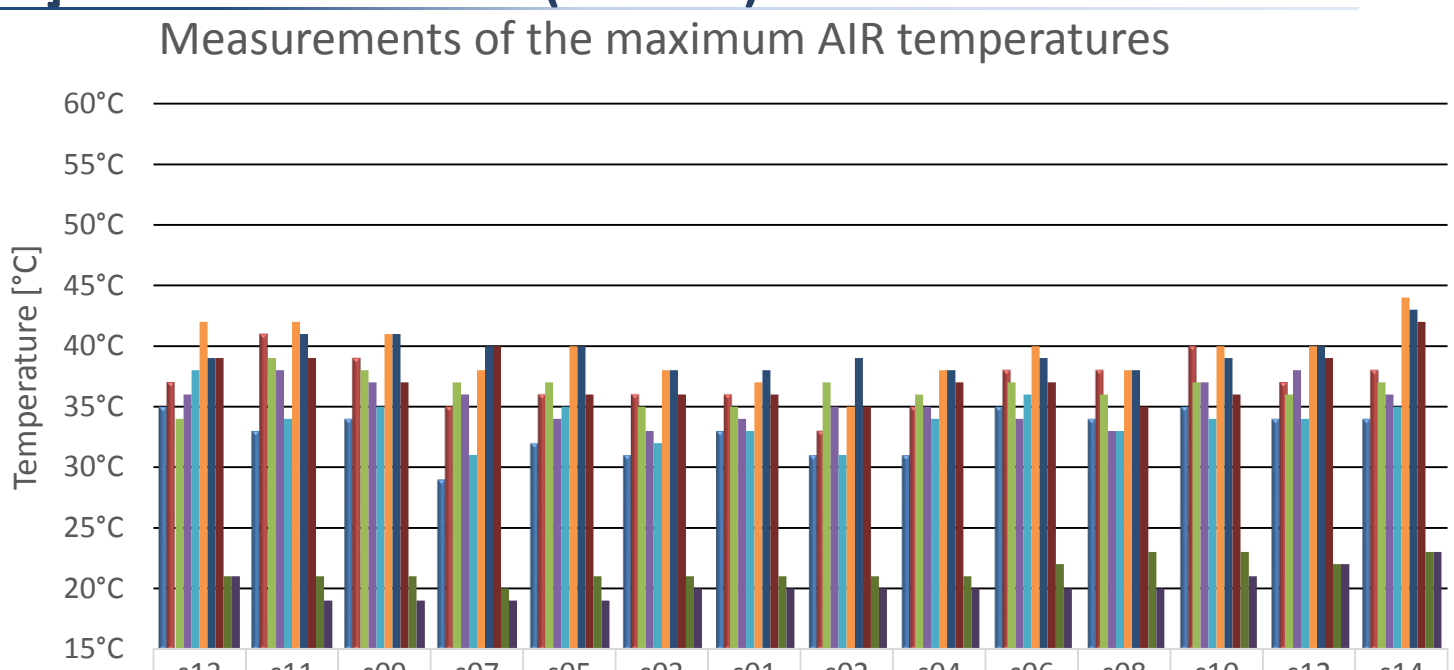
Lower power due to an hardware issue

ATCA2 14x350[W] – Comtel Load Boards (Top)
ATCA1 14x350[W] – Asis Load Boards (Bottom)



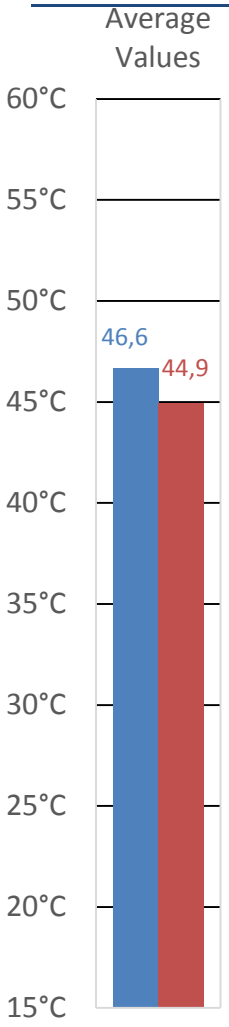
With Bottom Fans

Without Bottom Fans



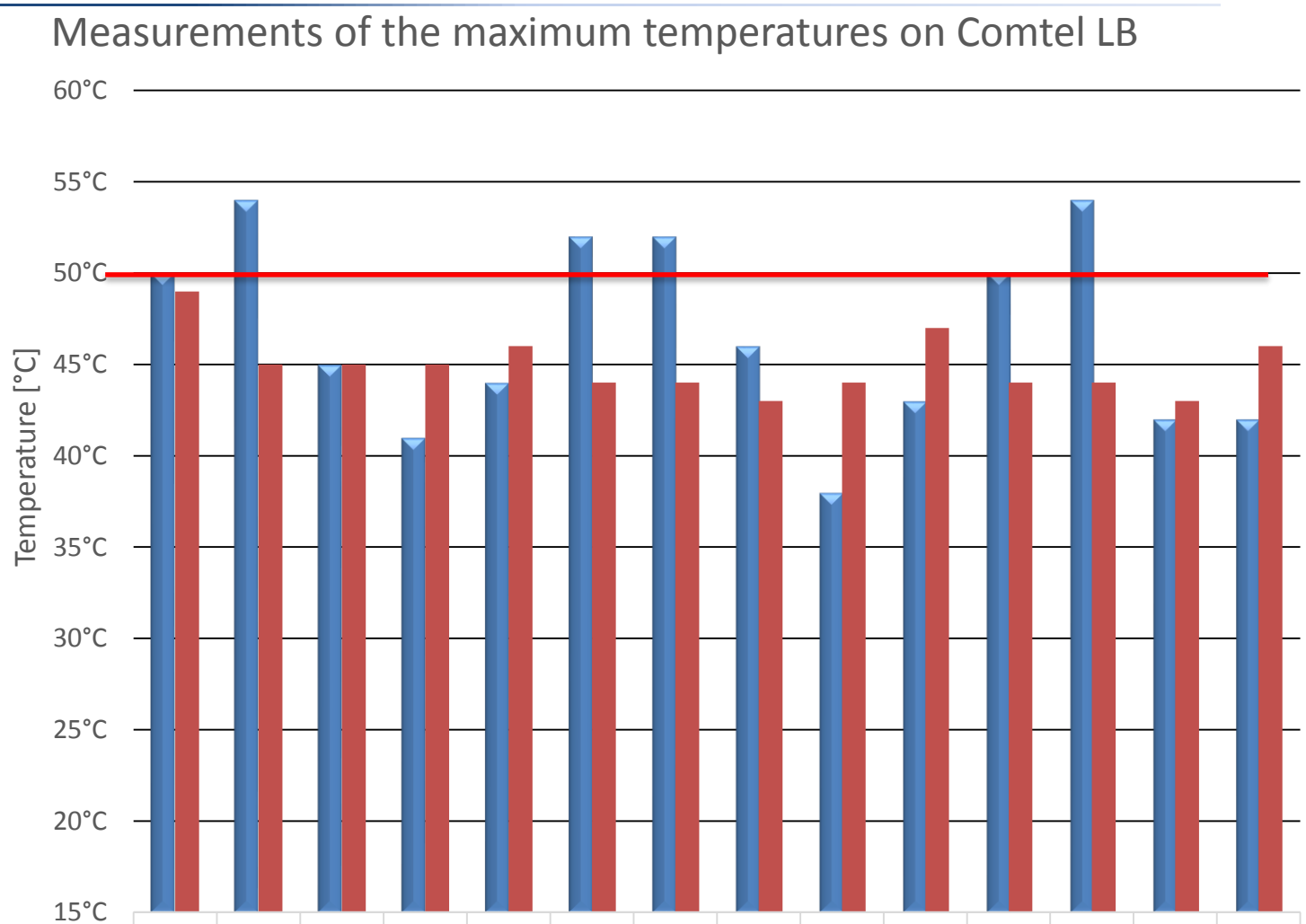
	s13	s11	s09	s07	s05	s03	s01	s02	s04	s06	s08	s10	s12	s14
Zone 1	35	33	34	29	32	31	33	31	31	35	34	35	34	34
Zone 2	37	41	39	35	36	36	36	33	35	38	38	40	37	38
Zone 3	34	39	38	37	37	35	35	37	36	37	36	37	36	37
Zone 4	36	38	37	36	34	33	34	35	35	34	33	37	38	36
Zone 1 WOUTBF	38	34	35	31	35	32	33	31	34	36	33	34	34	35
Zone 2 WOUTBF	42	42	41	38	40	38	37	35	38	40	38	40	40	44
Zone 3 WOUTBF	39	41	41	40	40	38	38	39	38	39	38	39	40	43
Zone 4 WOUTBF	39	39	37	40	36	36	36	35	37	37	35	36	39	42
Inlet 1	21	21	21	20	21	21	21	21	21	22	23	23	22	23
Inlet WOUTBF	21	19	19	19	19	20	20	20	20	20	20	21	22	23

ATCA2 14x350[W] – Comtel Load Boards (Top)
ATCA1 14x350[W] – Asis Load Boards (Bottom)



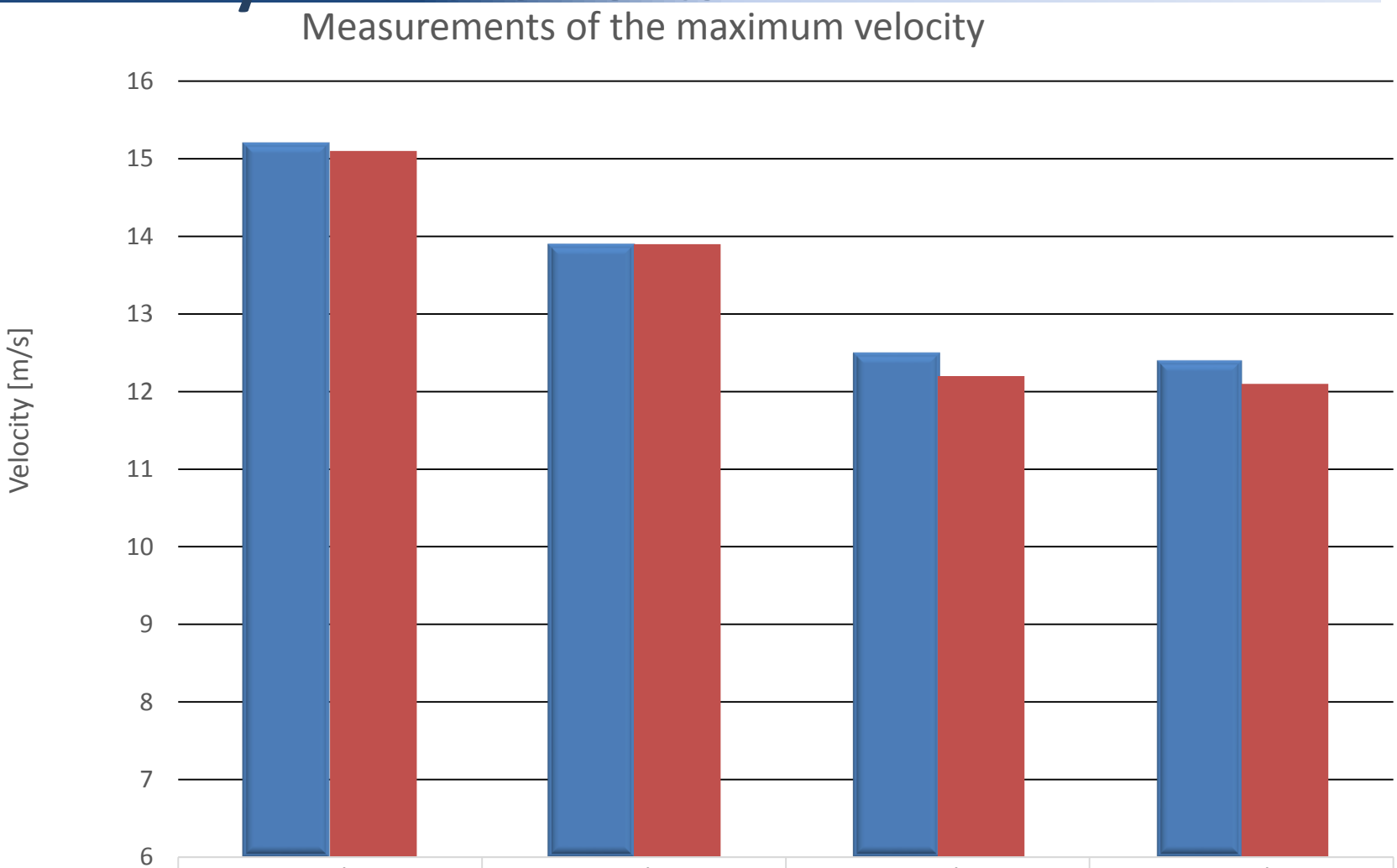
With Bottom Fans

Without Bottom Fans



	s13	s11	s09	s07	s05	s03	s01	s02	s04	s06	s08	s10	s12	s14
Zone 4	50	54	45	41	44	52	52	46	38	43	50	54	42	42
Zone 4 WOUTBF	49	45	45	45	46	44	44	43	44	47	44	44	43	46

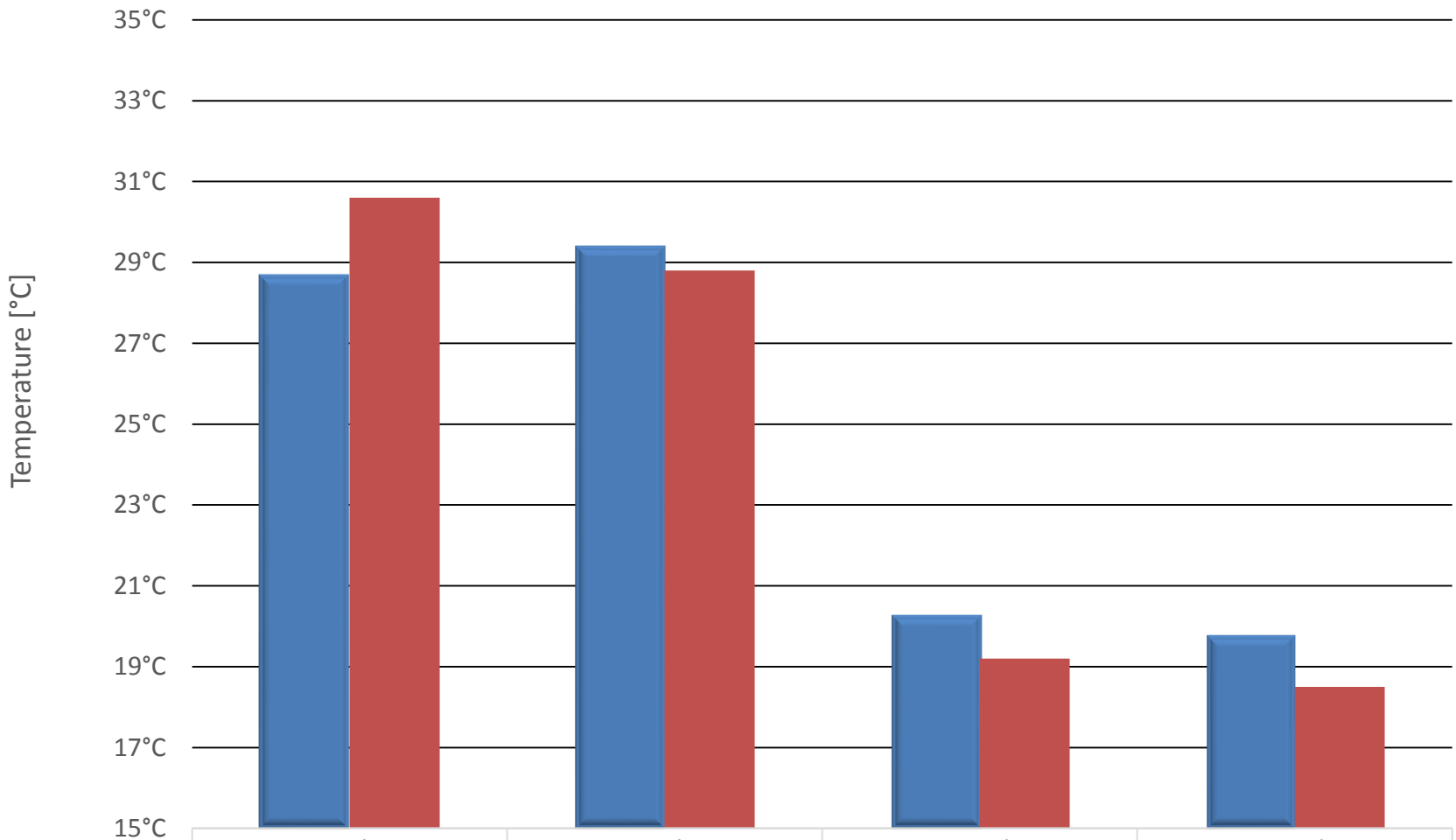
Air velocity measurements



	V4 - Rear in the center - ATCA Comtel	V5 - Rear in the center - ATCA ASIS	V7 - Front in the center - ATCA Comtel	V6 - Front in the center ATCA - ASIS
2xHC 16U With BF	15.2	13.9	12.5	12.4
2xHC 16U Without BF	15.1	13.9	12.2	12.1

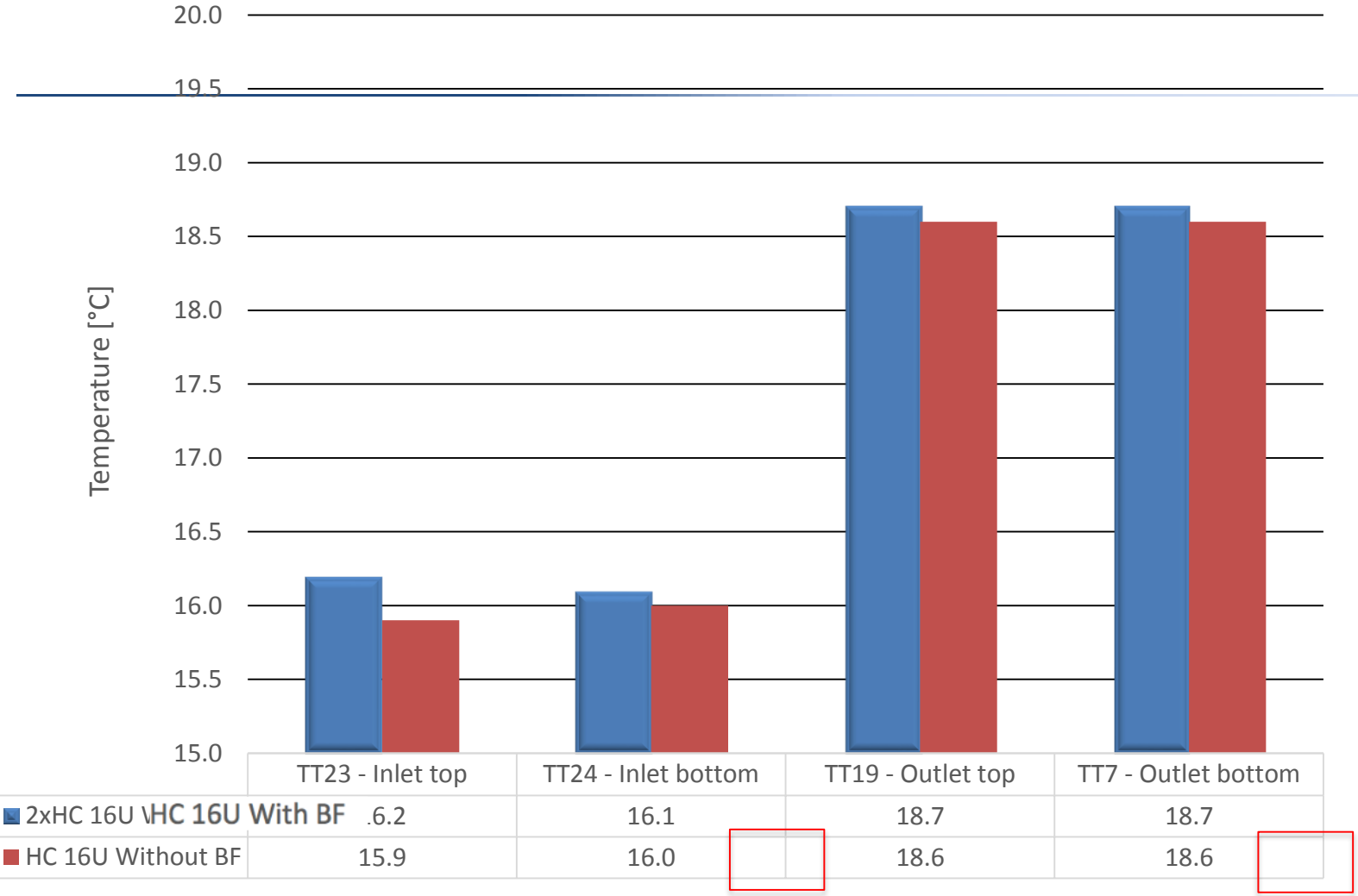
Shelves Air Temperature inlet - Outlet

Measurements of the maximum temperature



	V4 - Rear in the center - ATCA Comtel	V5 - Rear in the center - ATCA ASIS	V7 - Front in the center - ATCA Comtel	V6 - Front in the center ATCA - ASIS
2x HC 16U With BF	28.7	29.4	20.3	19.8
2x HC 16U Without BF	30.6	28.8	19.2	18.5

Water Temperature Inlet/Outlet



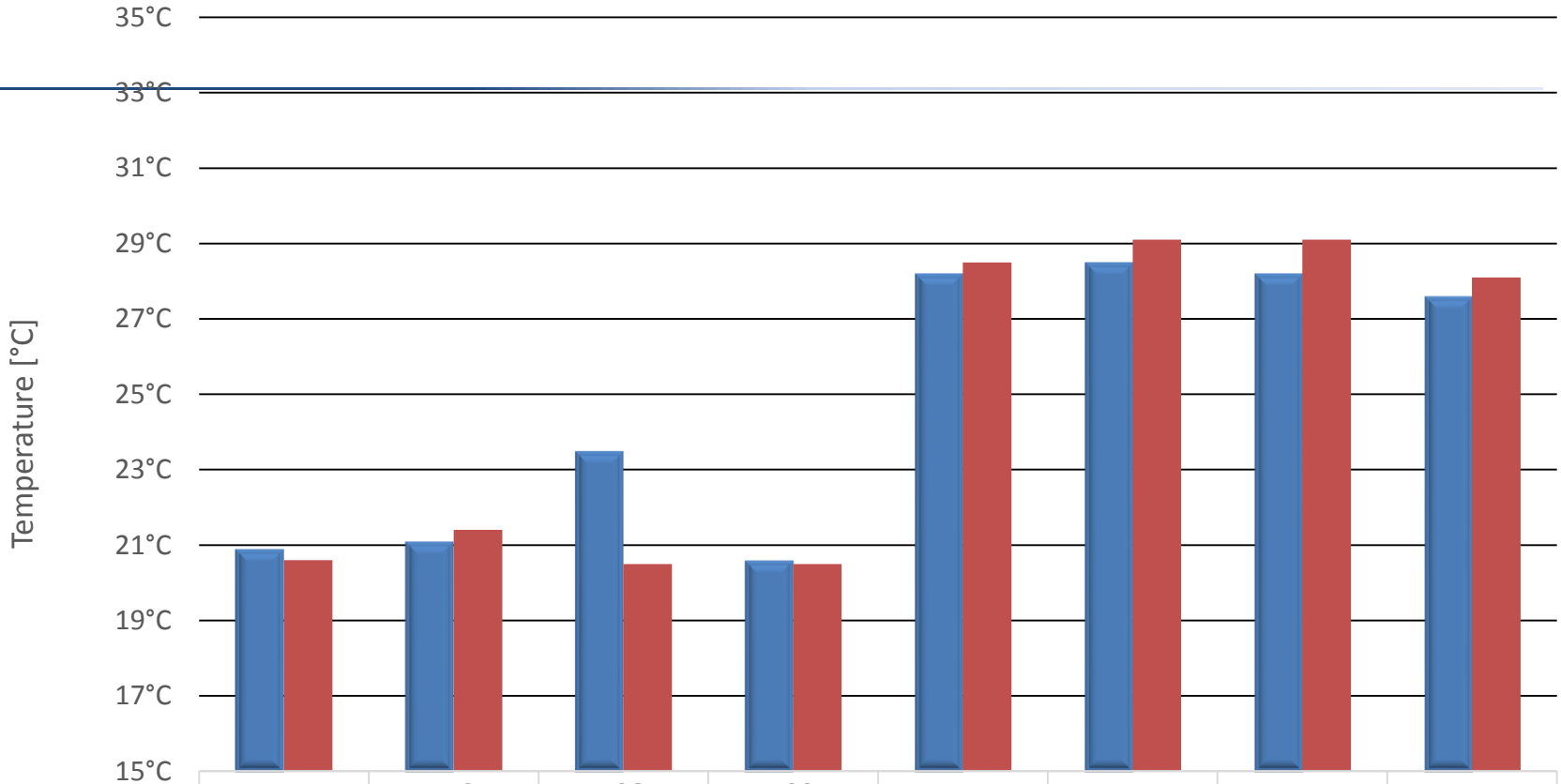
	TT23 - Inlet top	TT24 - Inlet bottom	TT19 - Outlet top	TT7 - Outlet bottom
2xHC 16U \HC 16U With BF	.6.2	16.1	18.7	18.7
HC 16U Without BF	15.9	16.0	18.6	18.6

Mixed water data taken while the shelves were fully powered

- Flow: 1.8 m^3/h
- T inlet 16 C, T outlet 18.6 C

$Q = mC_p (T_{out} - T_{in}) = 0.5 \times 4.18 \times (18.6-16) =$
$=$ **5.43 kW (50% of the total power)**

Cooling Door Air Temperature Inlet/Outlet



	TT17 - Outlet First Fan	TT18 - Outlet Second Fan	TT30 - Outlet Third Fan	TT29 - Outlet Fourth Fan	TT22 - Inlet First Fan	TT21 - Inlet Second Fan	TT27 - Inlet Third Fan	TT28 - Inlet Fourth Fan
2xHC 16U With BF	20.9	21.1	23.5	20.6	28.2	28.5	28.2	27.6
2xHC 16U Without BF	20.6	21.4	20.5	20.5	28.5	29.1	29.1	28.1

	V7 - Front in the center - ATCA Comtel	V6 - Front in the center ATCA - ASIS
With BF	20,3	19,8
Without BF	19,2	18,5

Inlet air T

The air T outlet is about 2.5 degrees higher of the environmental temperature.

ATCA shelf and rack cooling evaluation and tests

Measurement summary

Vertical Cooling

- Removing the shelves bottom fans we observed a more homogeneous flow distribution and the average temperature in the load boards decreased significantly.
- The 4th Heat exchanger is required to keep the temperature below 50C, the best average boards T achieved was about 46C.
- Shelves are noisy (safety measures must be taken: sounds barriers etc.)

Horizontal cooling:

- Removing the shelves bottom fans we observed a more homogeneous flow distribution and the average temperature in the load boards decreased significantly.
- The best average boards T achieved was about 45C
- The environmental temperature could become an issue once equipping the room with many shelves.
- Shelves are very noisy (safety measures must be taken: sounds barriers etc.)

Full rack cooling test report available upon request

Noisy measurements (HSE group): Horizontal shelves

Lieu de mesure		L_{Aeq} (dB(A))
Mesure 1	Dist. 80 cm	89.8
Mesure 2	Dist. 140 cm	86.5
Mesure 3		82.4
Mesure 4		80.6

HSE expert report:

- >85 db for 8 hours a day required safety personal protection and a yearly medical check for the operators
- The level of noise increased of 3 db every time the number of equipment is doubled
- For future installations in the room it will be required to take actions in order to reduce the level of noise (acoustic isolation panels, etc.)

For safety reasons the access to the counting room once equipped with many racks will be allowed only to people that followed the required safety training, wearing the ears protection equipment, and the daily exposition to the noisy must be limited.

Evaluated MicroTCA commercial equipment

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

ATCA shelf specification proposal

Informal MS outcome

	ASIS	Pentair Schroff	ELMA	Comtel
Which standard catalogue shelf type(s) fulfils all or part of the requirements given in the tech. spec?	For the F2B chassis it's our MaXum550. For the B2T chassis it's the MaXum450.	The platform which fits best in our 450/40 crate 14 slots p/n 1199010x.	Please find attached our compliancy matrix for one of the latest ELMA ATCA model CAP004406 vs. your technical specification.	No precise reference given but a compliant horizontal version is available.
Which options and/or requirements from the spec. can currently not be provided?	The non-compliant key points are listed below. In most cases these can be addressed by a redesign at fixed NRE costs and depending on total shelf quantities.			
Could these requirements be developed and/or adapted at defined NRE costs?	YES – any changes that you would like to implement according to the standard or customizing the standard we can develop for you.	The technical requirements can be met by a custom design. NRE costs will occur but the volume of these costs depends on the quantities and the grade of customization.	There are some points where we are partial or even not compliant. Most of them can be solved with a modification or redesign.	Yes, for all, see the details.
Non-compliant key points	None	No 100 G yet No full-mesh topology (not on their roadmap) No vertical cooling (custom dev. possible depending on volume)	100 G not on roadmap No vertical cooling (could be done at defined NRE) Fan trays without IPMC and not hot swappable	No vertical cooling (could be done at defined NRE)

Detailed answers available upon request.