
Open. Together.
OCP
SUMMIT

ACS Immersion

Immersed Computing® for OCP

Rolf Brink, Asperitas

OPEN COMMUNITY®

Passive open bath immersion

Open bath

Commodity liquid

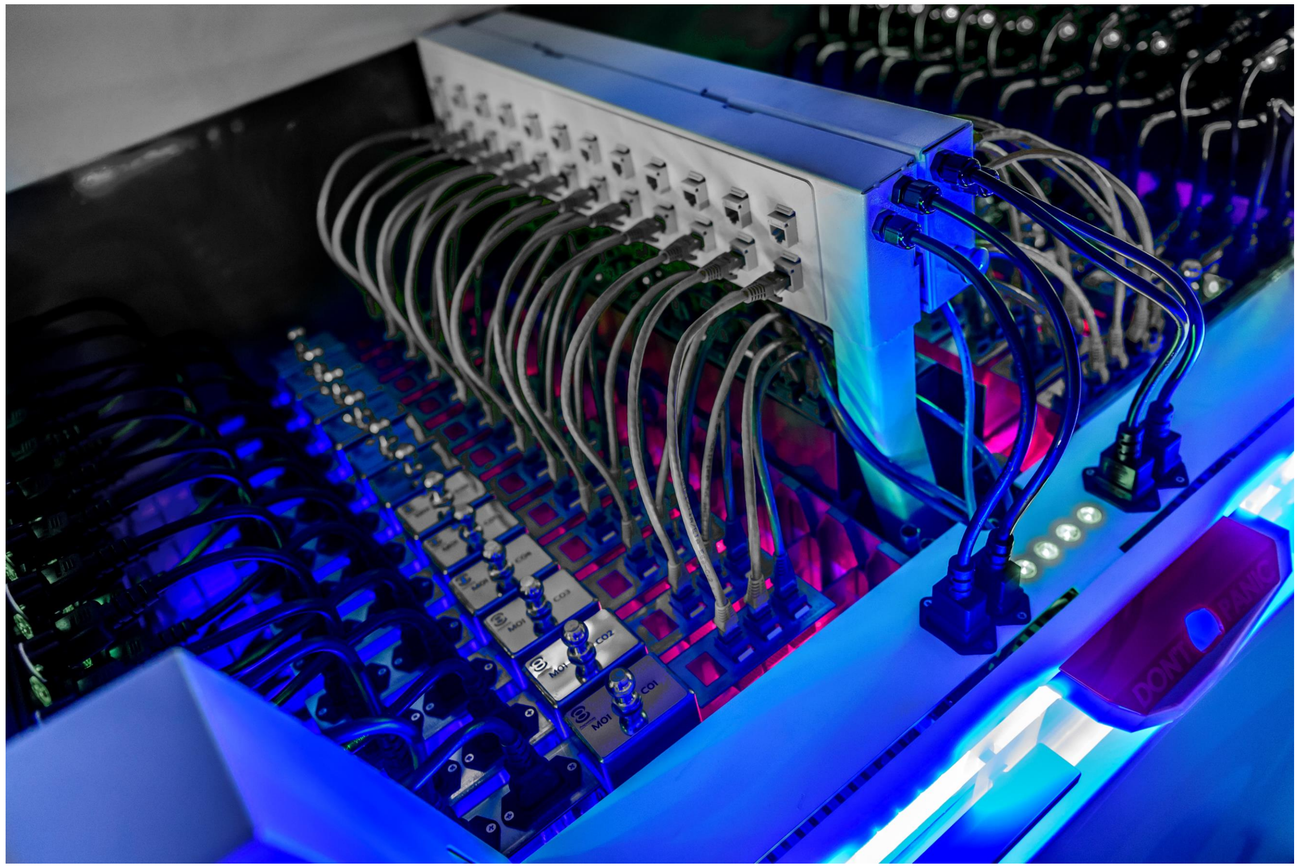
- Single phase
- Hydrocarbon (synthetic)

CE certified

Integrated management

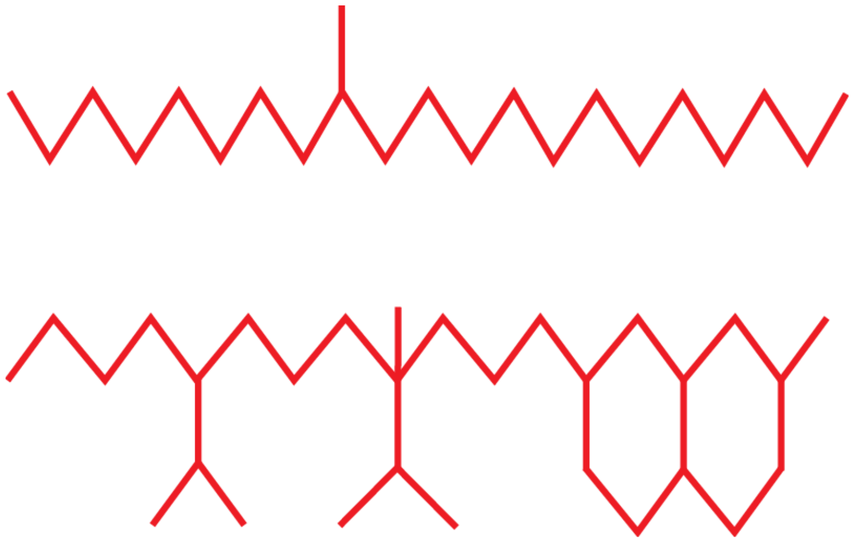
- Thermal optimized
- High safety

Dual hull, thermally insulated



Commodity hydrocarbons

Synthetic oils: Gas to Liquid (GTL) technology
Availably from most manufacturers



Molecular representation of
GTL vs mineral based oils

GTL quality

High purity

Odourless contain virtually no sulphur, nitrogen or aromatics

High temperature performance

Excellent thermodynamic properties and thermal stability

Low evaporation loss, Polycyclic Aromatic Hydrocarbon (PAH) & Volatile Organic Compounds (VOC)

Improve health, safety and working environment standards

Medicinal grade

Meets FDA § 178.3620 (a) requirements and NSF food grade certificate

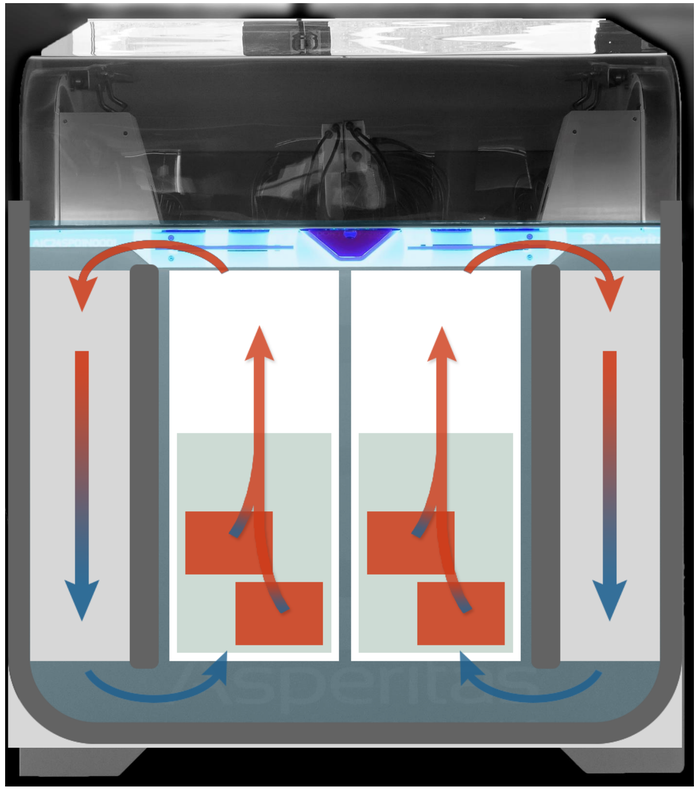
Enterprise quality immersion

Reliable

- Passive cooling
- Self regulating
- Redundant water/power

Power efficient

- No pumps
- Fully insulated



Self contained

- Integrated power
- Integrated safety
- Integrated mmt

IT compatibility

- Fully optimized
- Liquid certified
- Brand agnostic

ACS Compliant Power and Density data

Non-IT Power overhead

- Power/kW IT: 0 W/kWIT
- Management: 80W

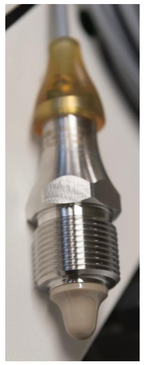
IT density*

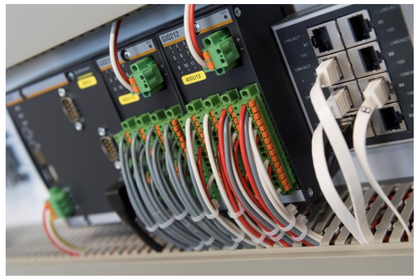
- Compute density: 34 kW/m2, 40°C
- Solution density: 28 kW/m2, 40°C
- Solution footprint: 17 kW/m2, 40°C
- ASHRAE W3 Solution footprint: 23 kW/m2, 32°C

Check out the in-depth session at 15:30, Immersion standards

Thermal optimization and high safety

	Sensors (reporting)	**Control**	**Auto safety**
Power	Amps, Voltage, VA, W (Feed & per outlet)	On/off	On/off
Water	Temperature (in/out) Flow & Pressure	Control and safety Valves	Open/close
Oil	Temperature (in/out) Volume Quality	Control	





Management integration

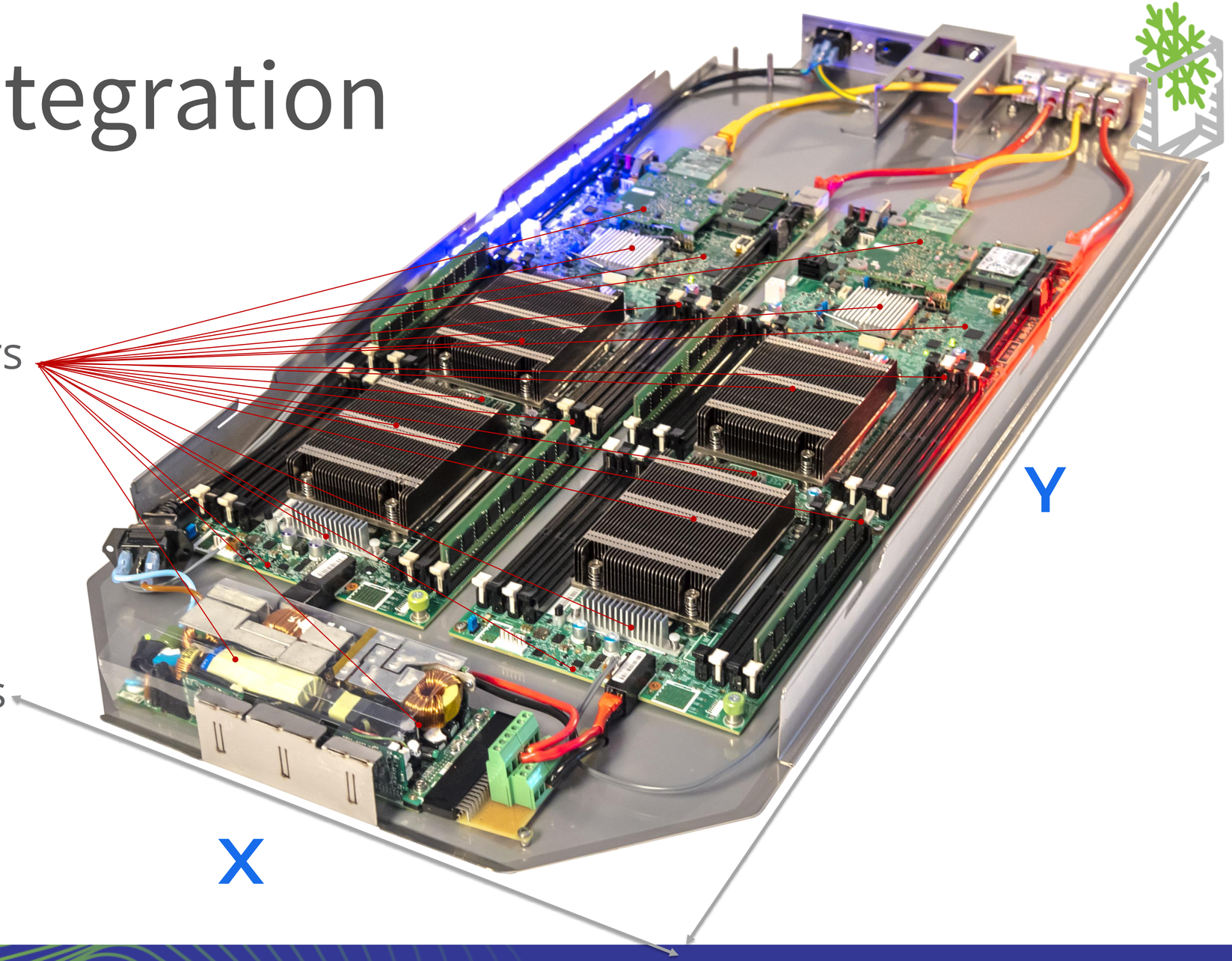
Server mainboards

- Built-in Temperature sensors
- Mapped X/Y coordinates
- Temperature map template

Data extraction with IPMI

Management integration

- Cassette location awareness
- Z-coordinate
- 3D location of sensors



Combining IT and system data

1000+ thermal sensors

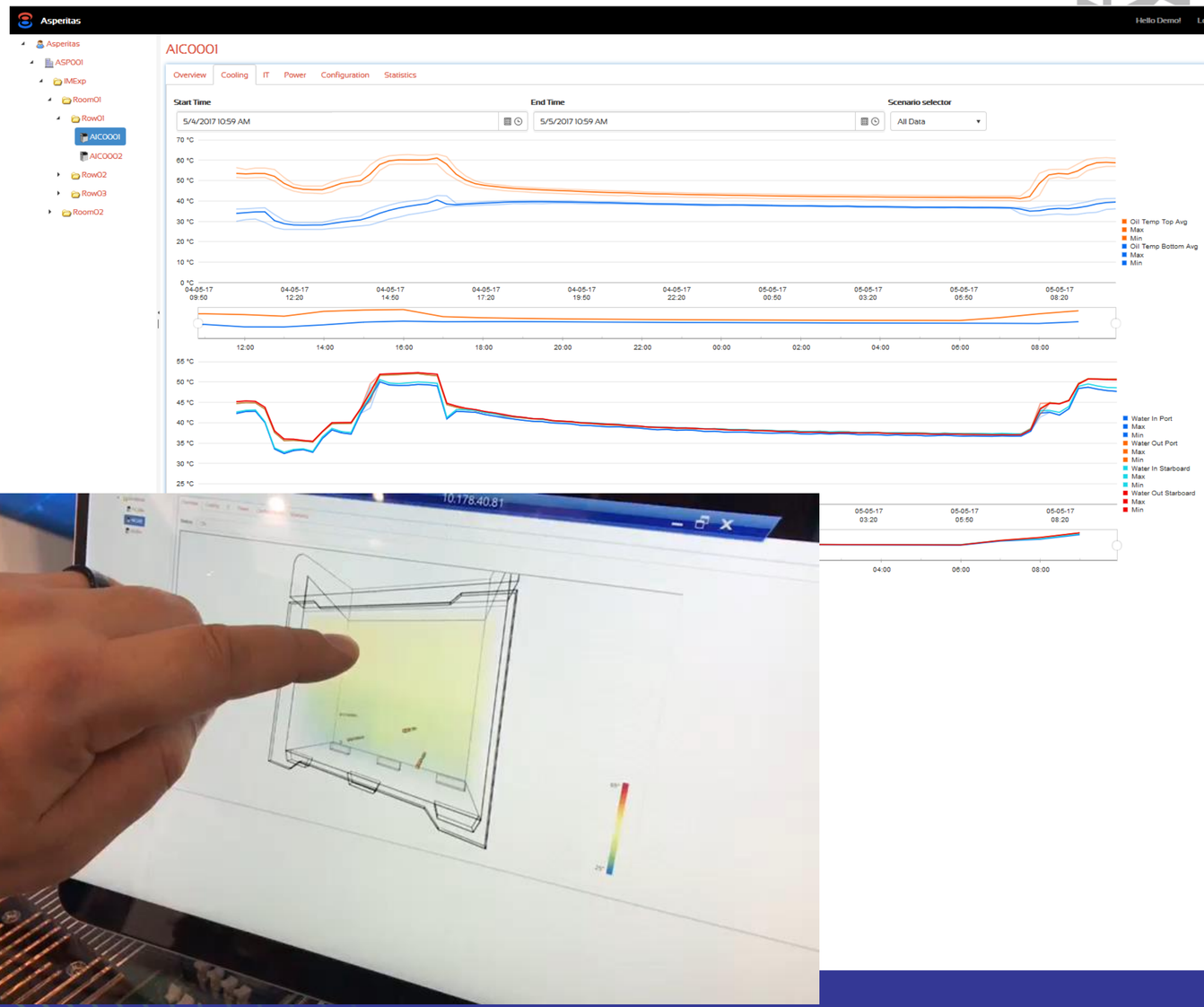
- Integrated temperature sensors
- IT temperature readings

Temperature logging

- Trend analysis
- Fault analysis

Thermal analysis

- Real-time IT health
- Dielectric thermal behaviour



Think about servicing & containment

Service trolley

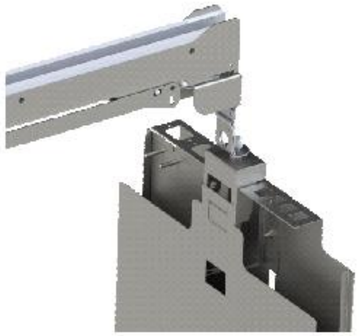
- Server lift (interface contribution)
- Wet IT gear handling and transport
- Whitespace maintenance
- Filtration

Containment

- Server leak trays
- Suitable absorbent materials
- Spill management

Video link: https://www.youtube.com/watch?v=V_OYSI-G5uU

Cassette considerations



Vertical orientation!!!

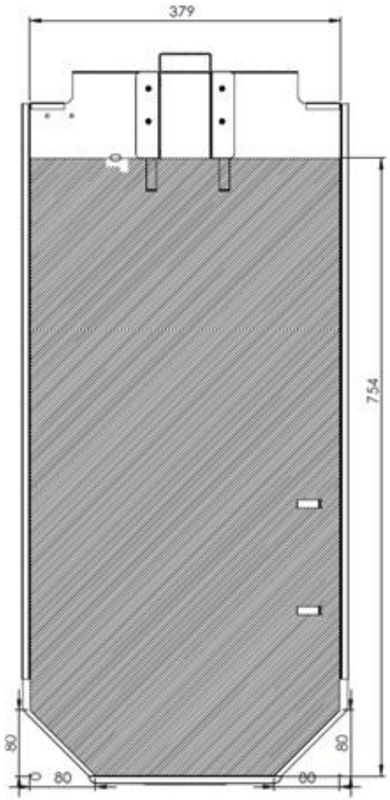
- Fixation in rack (prevent movement/floatation)
- Gravity
- Serviceability, dry interfaces
- Extraction

Chassis dimensions

- Varying sizes (15”,19”,21”)
- dual-board+ chassis

Unobstructed liquid flow

- Sideways outflow on surface
- Cooled liquid distribution/levelling on bottom



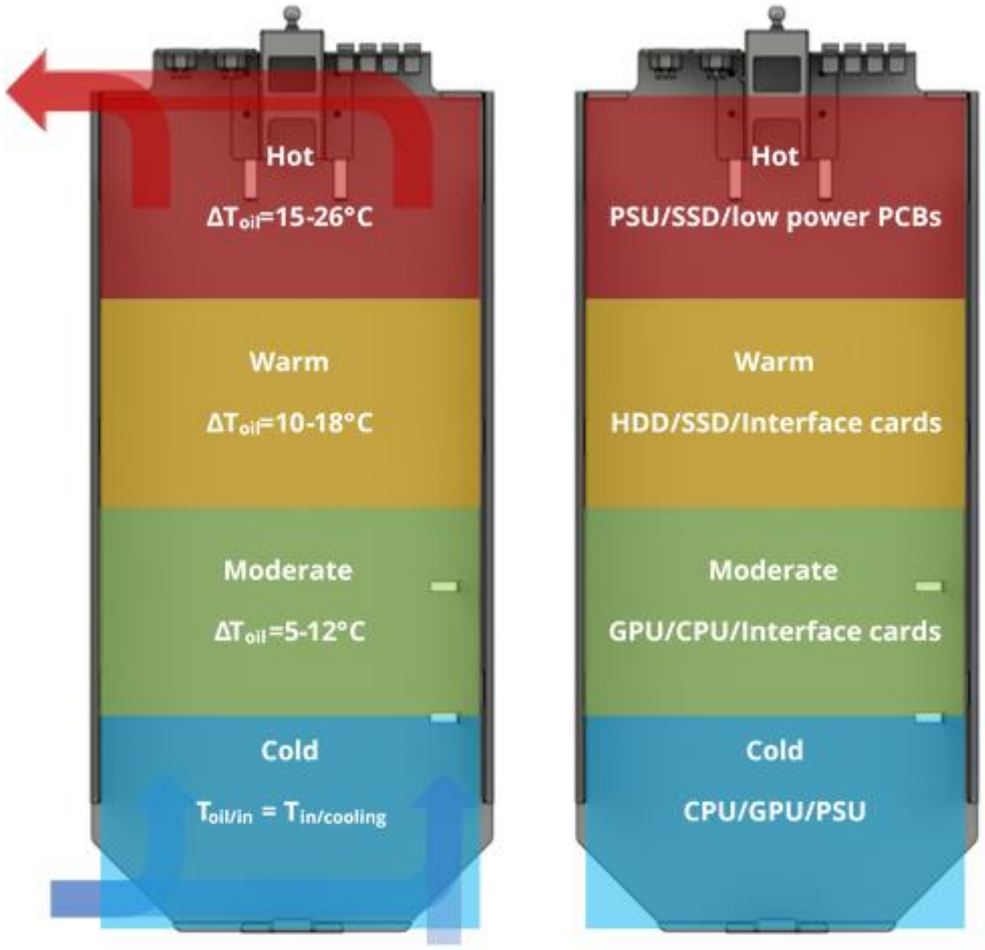
Thermal design guidelines

Cooling input at bottom (coolest liquid)

Cooling output on top (hottest liquid)

Component placement considerations

1. Thermal tolerance
2. Thermal load (rate of heating)
3. Thermal buffering
4. Fluid dynamics



IT Certification

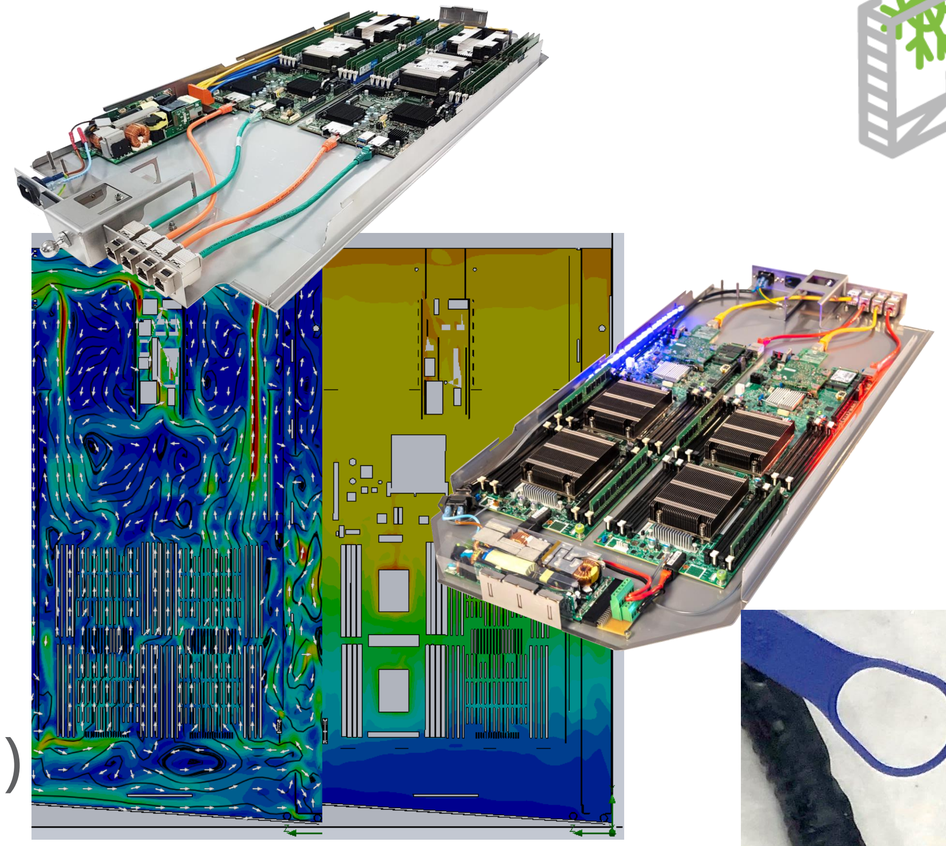
Focus on material compatibility R&D (Potentially destructive)

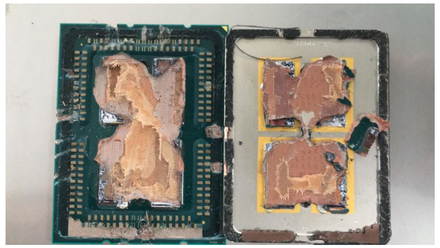
Optimization of thermal tolerance

Long term risk assessment

Staged certification:

- Level 1, feasibility study (material and thermal) (2 weeks)
- Level 2, prototyping & benchmark test (2 weeks)
- Level 3, 10-week duration and test





PASS

FAIL

Maximizing thermal tolerance

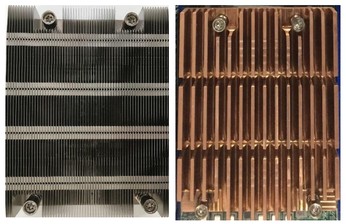
2. CERTIFICATION RESULT

2.1 SUMMARY

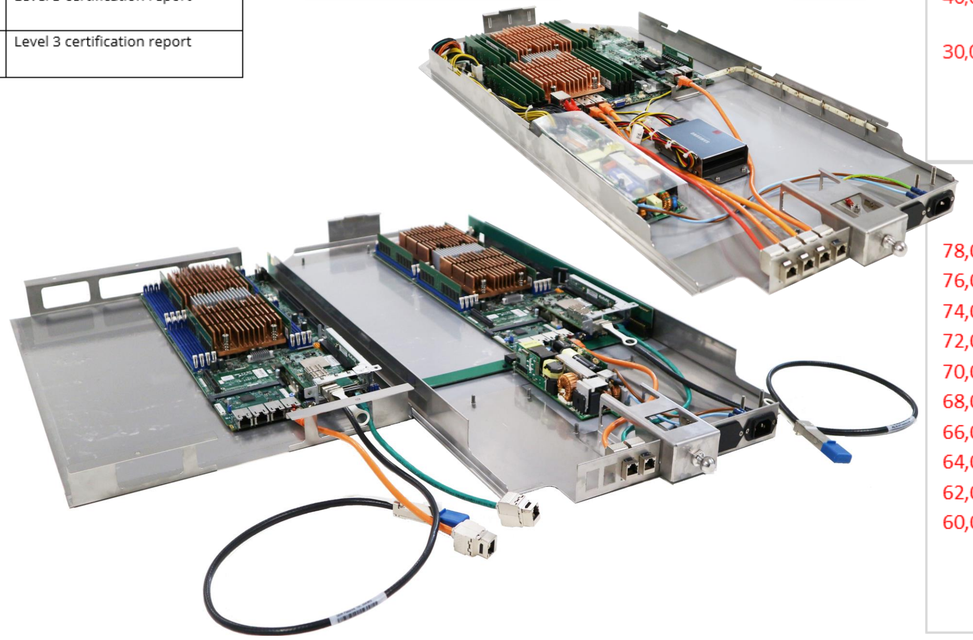
SYSTEM CODENAME	PRODUCT CODE
[redacted]	[redacted]

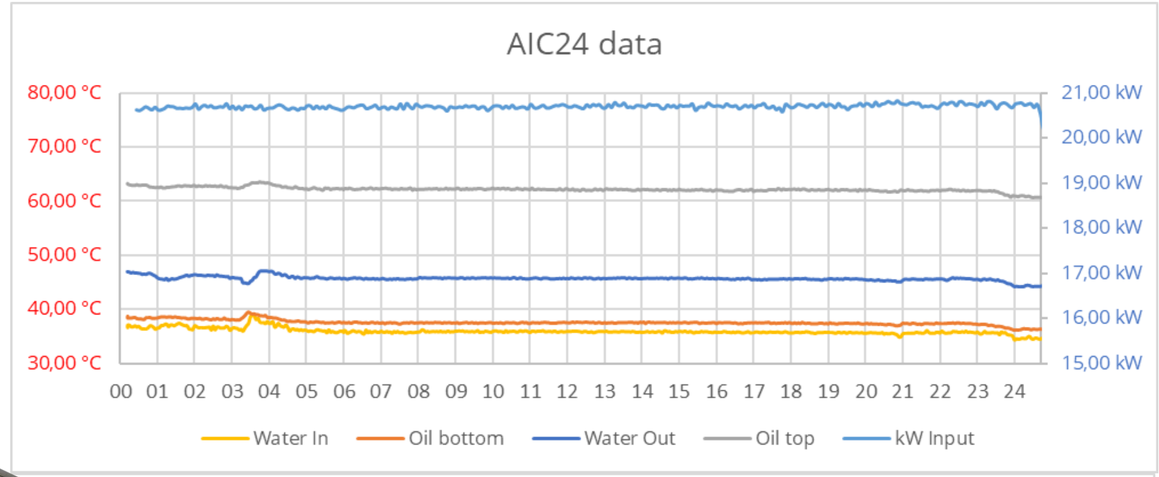
CERTIFICATION	RESULT	NOTES/CONDITIONS
DURATION STRESS TEST	PASS	None
COMPONENT VERIFICATION	PASS	None
DURATION TEST REPORT	Completed	Level 3 certification report
COMPONENT VERIFICATION REPORT	Completed	Level 3 certification report
BILL OF MATERIALS	Completed	Level 3 certification report
ASSEMBLY INSTRUCTIONS	Completed	Level 3 certification report

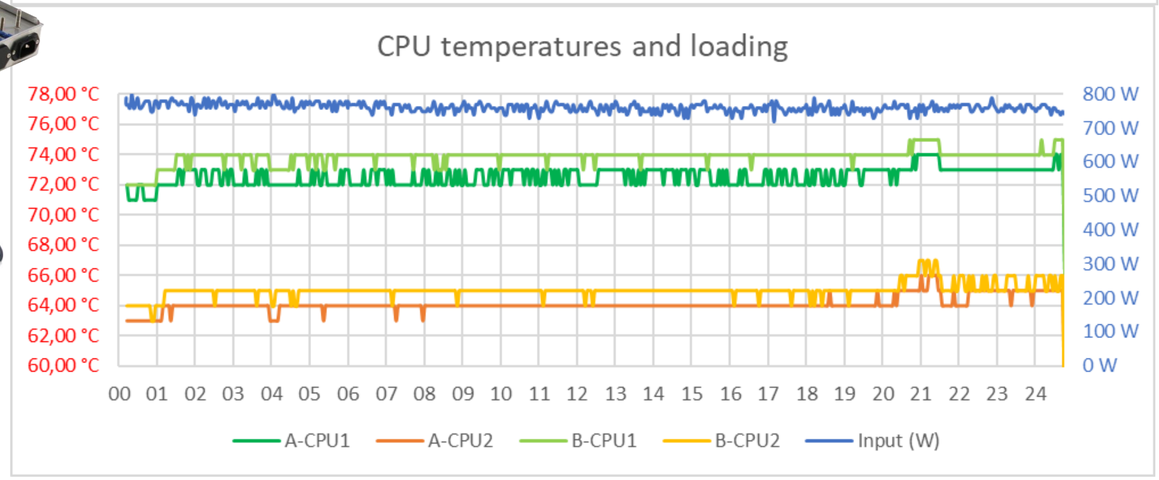
STATISTICS	MEASURED
Peak power consumption Stresslinux	795 W
Peak power consumption SPECrate2017	453 W
Max cooling temperature estimate	48°C
Max cooling temperature tested	41°C
SPECrate test result	183



	BOARD A		BOARD B	
COMPONENT (IPMI)	AVG	MAX	AVG	MAX
B-BB BMC	48 °C	57 °C	48 °C	57 °C
B-BB CPU1 VR	55 °C	67 °C	52 °C	62 °C
B-BB CPU2 VR	46 °C	58 °C	45 °C	55 °C
B-BB Inlet	35 °C	45 °C	35 °C	45 °C
B-BB Outlet	50 °C	59 °C	50 °C	59 °C
B-LAN NIC	54 °C	63 °C	53 °C	62 °C
B-Mem 1 VRD	49 °C	58 °C	47 °C	58 °C
B-Mem 2 VRD	37 °C	46 °C	38 °C	47 °C
B-P1 T_{DTS}	90 °C	104 °C	83 °C	97 °C
B-P1 T_{CASE}	68 °C	80 °C	71 °C	82 °C
B-P2 T_{DTS}	78 °C	92 °C	73 °C	87 °C
B-P2 T_{CASE}	56 °C	68 °C	60 °C	72 °C
A-SSB	52 °C	61 °C	52 °C	62 °C







Contributions to facilitate harmonization

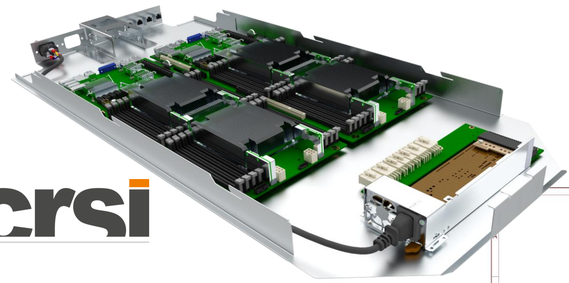
Asperitas IMMERSED COMPUTING® & 2CRSI

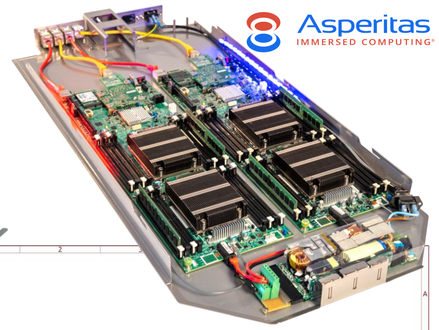
Hoisting/lifting interfaces

- March 2019
- Design specs, boom interface, chassis interface

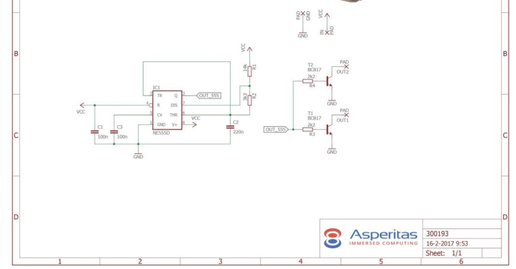
Asperitas/2CRSI joint universal server spec with dual 7” board lay-out

- June 2019 launch of integrated Intel OCP platform
- Cassette designs, thermal optimization, interfaces
- New 19” & 21” AI designs Q3/4



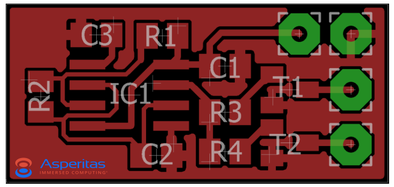


2CRSI

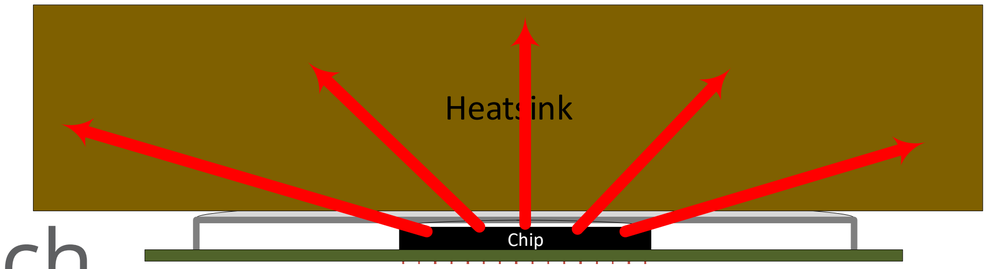


Various tooling designs

- On-going
- Fan simulators, Service lift, heat sinks, etc.

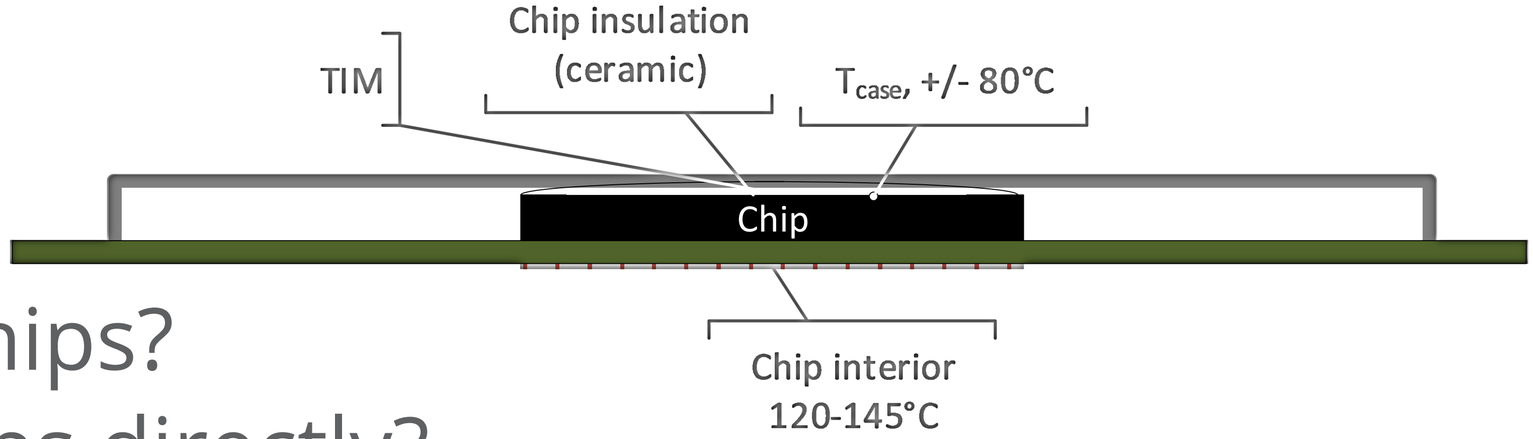


Chip design for liquid



2-dimensional problem approach

- Chip packaging suboptimal for thermal properties
- Electrical insulation= thermal insulation



Liquid opportunity

- Cooling rear-side of chips?
- Cooling interior of chips directly?
- Dielectric liquid as insulation for internal circuit?

3D "open structure" chip designs possible?

ACS – Immersion workstream

Join the immersion workstream and contribute!

https://www.opencompute.org/wiki/Rack_%26_Power/Advanced_Cooling_Solutions

Mailing list: http://lists.opencompute.org/mailman/listinfo/opencompute-acsimmersion

Email: Rolf.Brink@OCProject.net

Bi-weekly, 10:30-11:30am ET, (next call March 19th)

Next project: IT Gear specs, guidelines and best practices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