Open. Together.
Immersed Computing® for OCP

Rolf Brink, Asperitas
Passive open bath immersion

Open bath
Commodity liquid
• Single phase
• Hydrocarbon (synthetic)
CE certified
Integrated management
• Thermal optimized
• High safety
Dual hull, thermally insulated

Open. Together.
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/kW IT
• 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

<table>
<thead>
<tr>
<th>Sensors (reporting)</th>
<th>Control</th>
<th>Auto safety</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power</strong></td>
<td><strong>Amps, Voltage, VA, W (Feed &amp; per outlet)</strong></td>
<td><strong>On/off</strong></td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td><strong>Temperature (in/out) Flow &amp; Pressure</strong></td>
<td><strong>Control and safety Valves</strong></td>
</tr>
<tr>
<td><strong>Oil</strong></td>
<td><strong>Temperature (in/out) Volume Quality</strong></td>
<td><strong>Control</strong></td>
</tr>
</tbody>
</table>
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

Open. Together.
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_QYSI-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
Maximizing thermal tolerance

2. CERTIFICATION RESULT

2.1 SUMMARY

<table>
<thead>
<tr>
<th>COMPONENT (IPMI)</th>
<th>BOARD A</th>
<th>BOARD B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AVG</td>
<td>MAX</td>
</tr>
<tr>
<td>B-BB BMC</td>
<td>48 °C</td>
<td>57 °C</td>
</tr>
<tr>
<td>B-BB CPU1 VR</td>
<td>55 °C</td>
<td>67 °C</td>
</tr>
<tr>
<td>B-BB CPU2 VR</td>
<td>46 °C</td>
<td>58 °C</td>
</tr>
<tr>
<td>B-BB Inlet</td>
<td>35 °C</td>
<td>46 °C</td>
</tr>
<tr>
<td>B-BB Outlet</td>
<td>50 °C</td>
<td>59 °C</td>
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<tr>
<td>B-LAN NIC</td>
<td>54 °C</td>
<td>63 °C</td>
</tr>
<tr>
<td>B-Mem 1 VRD</td>
<td>49 °C</td>
<td>58 °C</td>
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<tr>
<td>B-Mem 2 VRD</td>
<td>37 °C</td>
<td>46 °C</td>
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<tr>
<td>B-P1 Ters</td>
<td>90 °C</td>
<td>104 °C</td>
</tr>
<tr>
<td>B-P1 TDTS</td>
<td>68 °C</td>
<td>80 °C</td>
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<tr>
<td>B-P2 Ters</td>
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<td>82 °C</td>
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<tr>
<td>B-P2 TDTS</td>
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<td>68 °C</td>
</tr>
<tr>
<td>A-SSB</td>
<td>52 °C</td>
<td>62 °C</td>
</tr>
</tbody>
</table>

AIC24 data

CPU temperatures and loading
Contributions to facilitate harmonization

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

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