Cooling Datacenters with Air was Never a Good Idea

ITherm 2014
Air Cooling – A Bad Idea

Air is an Insulator!
Cold Air Sinks!
Humidity Control is Essential!
Air Corrodes Contacts!
Pollution Degrades Electronics!

*Tweaking air cooling to make it a bit better makes no sense*

*Making liquid cooling practical is the right answer*
Fans are the Problem

**Fans Waste Energy**
- 15% of total datacenter energy is used to move air
- Additionally fans in the chassis can use 20% of IT power
- Fans are inefficient and generate heat that must be removed

**Fans Waste Space**
- Racks need room to breathe
- CRAC units require space around the racks
- White space often requires raised floors and high ceilings

**Fans Reduce Reliability**
- Fans fail
- Thermal fluctuations drive solder joint failures
- Fretting induced by vibration corrodes electrical contacts
- Fans expose electronics to air
  - Oxidation/corrosion of electrical contacts
  - Exposure to electrostatic discharge events
  - Sensitivity to ambient particulate, humidity or temperature conditions
LCS Technology Eliminates Fans

**Patented Directed-Flow Technology**

- No fans or other moving parts in the chassis
- Total liquid submersion in a eco-friendly dielectric fluid
- Rack-mounted devices are easy to maintain
- Within a device “cool” liquid is circulated directly to the components with the highest power density
- The remaining components are cooled by bulk flow as the dielectric fluid is drawn through the unit to a return manifold
- Electronics are decoupled from the environment

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64-Server Configuration

Connection to remote CDU
Heat Dissipation

LCS Cooling System Elements

- Pump supplies “cool” dielectric liquid to multiple IT racks
- If there is no energy recycling option “hot” fluid is circulated to an evaporative fluid cooler
- Incoming “cool” fluid can be as warm as 45°C for most applications
Any Shape or Size

8 servers with liquid-to-liquid cooling distribution unit

Automotive application – 12vdc with built-in pump

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Low Cost “Clamshell ” Server

- Motherboard sandwiched between two sealed enclosures
- Rack-mountable
- I/O connectors remain outside the liquid enclosure
Clamshell server system configuration showing the key components of the system:

- 8x dual twin board Clamshell servers and 2x power modules per 10U of rack space
- Dual 8KW CDUs per 14U of Rack space
- Dry-side enclosures for removable HDDs and SSDs
- Front View

Dual twin-board Clamshell concept with dry-side enclosure

Liquid-cooled Power Supply module with 8x Redundant Power Supplies
1MW Hybrid Data Module

- Liquid cooled compute section
  - 25' x 12' partition comprised of 4 zones of 6 racks each

- Air cooled network switches and data storage section
  - 17' x 12' partition

- Four cooling modules – one per zone
  - Liquid to liquid
  - Fully redundant pumps and HEX units
  - Approximate capacity of 220 kW each
Cools High Power Electronics
- Lower operating temperatures result in lower leakage current
- All internal components are kept within normal operating temperature ranges

Saves Energy
- Device power-to-cool can be reduced by up to 98% vs. air-cooled devices
- As a result the “true” cooling PUE is 1.03
- Waste heat easily can be recovered for other uses

Saves space
- 64 IT devices in a 42U rack because there is no need for air circulation
- Higher rack density because there is no need for hot/cold aisles

Enhances Reliability
- Sealed fluid circuits prevent failures from corrosion and contamination
- Liquid submersion reduces thermal fatigue due to fluctuating temperatures
- Dielectric fluid outlasts the electronic components
- IT equipment can be easily accessed for upgrades
More Benefits

**Operates Silently** - Fan noise is eliminated

**Scalable** – Installations can range from one device to hundreds of racks

**Easy to Maintain** – IT devices in racks can be swapped in a few minutes

**Simplifies Upgrades**
- Cooling capacity accommodates increased heat loads from future IT devices.
- Only the motherboard needs to be exchanged as technology advances

**Any Shape or Size**

**Pick Your Supplier** - LCS does not manufacture IT equipment, but licenses patents

**Costs Less** – An LCS cooled datacenter costs less to build, provision, operate and renew
Questions

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