Rear Door Heat Exchanger

A method for DataCenter Thermal Management

Vinod Kamath
Power and Thermal Engineering
IBM Systems and Technology Group
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Problem Statement

- Rack Power loads are high due to increased compute density.
- The impact is seen in datacenters as high inlet air temperatures to the equipment.
- Datacenter flow balancing issues can create local hotspots as well.
- The consequence can be lowered system reliability and failures.
- High fan and blower speeds can be seen due to higher inlet temperatures.
- Added acoustics signatures of equipment can create user discomfort.
- Exit air temperatures from servers can be 50 deg C or higher
- "Maintaining Datacom Rack Inlet Air Temperatures with Water Cooled Heat Exchanger" - Schmidt et al., Proceedings IPACK2005.

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Solution Characteristics

- Localized spot treatment required
- Heat exchange with exit air provides the most efficient mechanism for temperature reduction
- A low airflow pressure drop solution can provide a "passive mechanism" for heat extraction
- Small footprint impact on existing datacenters of design.

Solution Details

- Replace an existing Rear Door with a heat exchanger
- The footprint increase is about 5.6" on the rack
- Uses existing hinge and latch assemblies with > 90 deg C open capacity
- Water delivered using 3/4" ID supply and return hoses
- Industry standard quick connect hydraulic couplings to door

Salient Features

- The heatexchanger is a tube-and-fin design with low air side pressure drop
- Operates using above dew point water
- Robust quality control in the braze process and build process
- Door design enables high strength-weight ratio (70 lb.)
- Protective barriers to fins
- Handles for Install

Rear Door Heat Exchanger

Standalone Performance

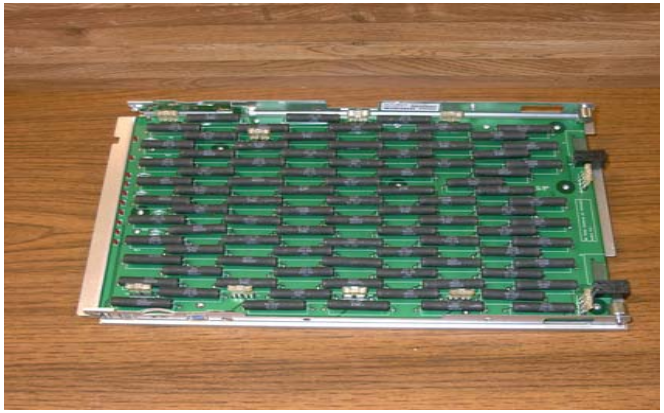
- **Rack Level Testing with high power density servers**
- **Bladecenters were used in the rack**
- **Functional 1U servers were used as well to determine heat extraction**
- **The tests were conducted in a room where the inlet temperature could be maintained between 23-25 deg C.**
- **The water flow rate was maintained at 7 GPM in the test cases and the water inlet temperature was kept at 17 deg C**

Test Results

- **The results for the BladeCenter and 1U rack servers show between a 50% to 60% heat extraction of the input heat load.**
- **The increase in airflow impedance to the servers can result in a marginal 1 deg C impact to the CPU temperatures due to a slight flow loss to the servers**
- **The exit air temperature from the RDHX is reduced by an average of 25 deg C from the discharge end of the servers.**

Blade Center Tests

- **Thermal Load Blade (250W-450W)**



Blade Center Tests

- 6 BladeCenter Chassis
- 5 Thermal Equivalent Chassis, 1 Functional Chassis
- Thermal Blade with Calibrated impedance and power
- Each Unit Calibrated to determine airflow and power
- Functional tests run at different airflow rates and power loads
- Data at 1530 CFM (approach flow)
- Water Flow at 7 GPM

Rack Power (kW)	Air Inlet to Rack (C)	Water Inlet(C)	Water Outlet(C)	Heat Extraction (kW)	Efficiency (% age)
16.3	26.8	17.3	23.4	12.02	49.9
31.5	24.5	17.1	26.9	18.12	49.9

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1U Tests

- 40 - x336 1U with Xeon 2.8 GHz CPUs
- 5 GPM Water at 17 deg C
- Measured Power 10.6 kW for Rack

Rack Power (kW)	Air Inlet to Rack (C)	Water Inlet(C)	Water Outlet(C)	Heat Extraction (kW)	Efficiency (% age)
10.6	24.5	18.3	22.8	5.94	56.0