How Liquid Cooling Helped Two University Data Centers Achieve Cooling Efficiency Goals

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Data Center Trends

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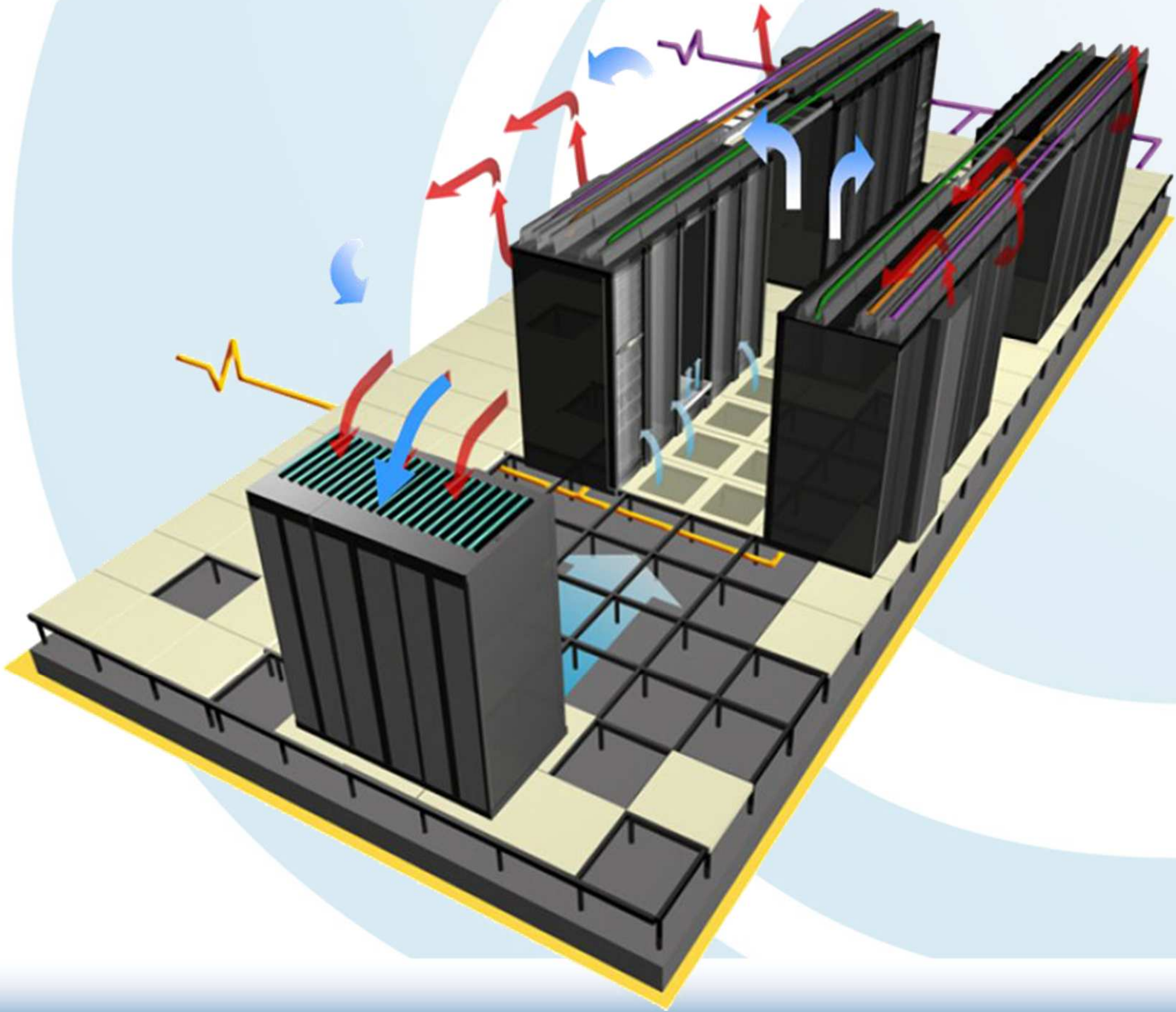
- Energy consumption in the Data Center (DC)
  - 2006 - 61 billion kWhr (~6 millions households) - 1.5% of the total USA electricity
  - 2012 - 100 billion kWhr (~10 million households) - 2.0% of the total ($7.4 billion cost)
- Energy Usage
  - ~40% of the electricity consumed in the DC = air conditioning system (~ $3 billion)
- Technology Trends
  - Energy consumption is the most dominant trend in the next 5 years (Gartner Group)
  - IT Equipment power density is increasing
  - Consolidation, virtualization and cloud computing lead to higher rack densities
  - Companies want to optimize their DC white space with higher density racks (fully populated) containing IT equipment that performs work (high utilization rate)
- DC Costs
  - Data Center costs can exceed $1,000/square foot, of which 70% goes toward mechanical, electrical and cooling

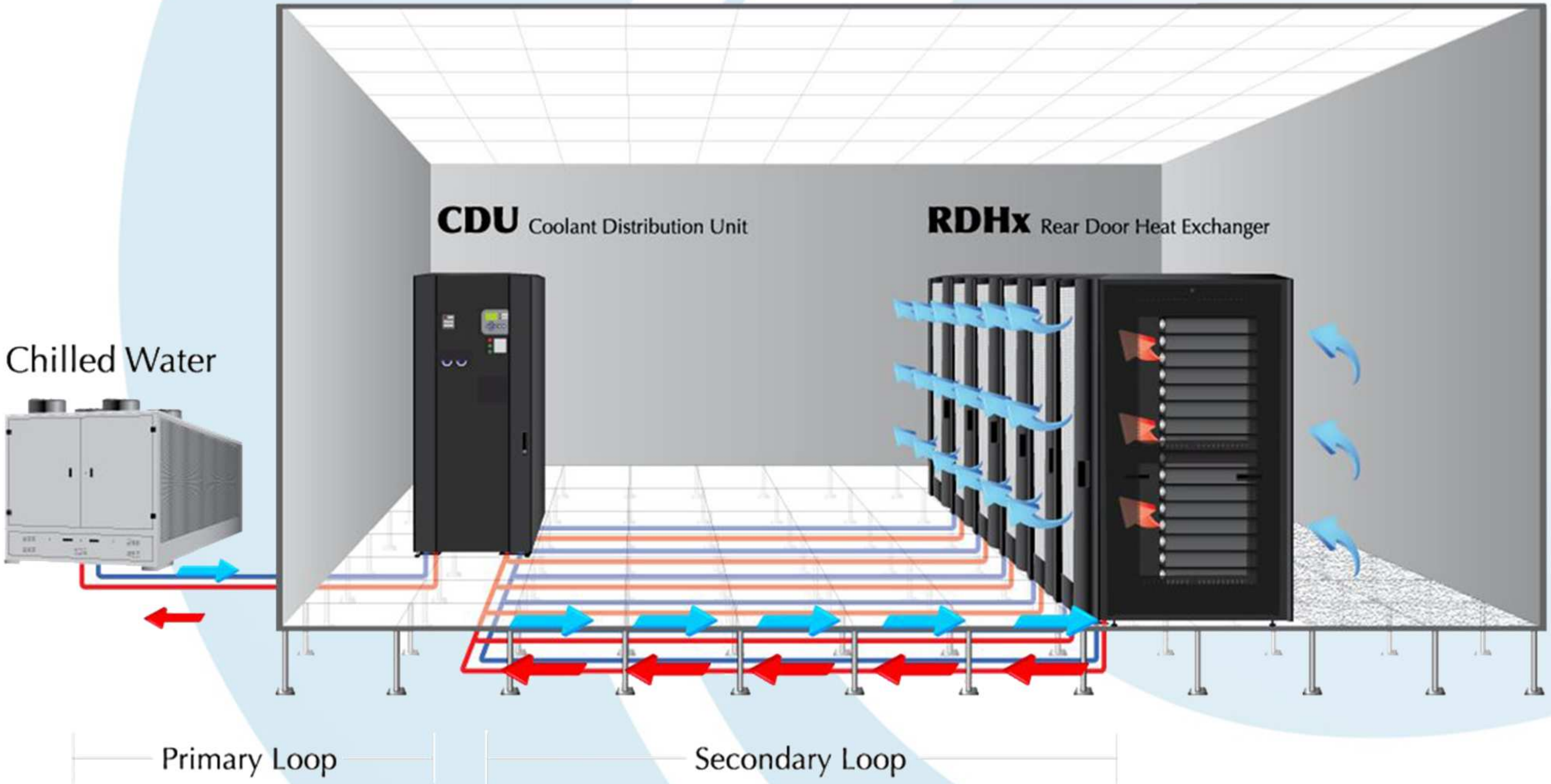
Data Center Trends

- Higher Education and HPC are early adopters of liquid cooling – no longer using air-cooling to remove all of the DC heat.
  The DC cooling needs are becoming more complex and exceed air cooling capabilities
- Traditional air-cooled systems cannot keep up with the changes
  - Inefficient - delivery system is inefficient leading to over provisioning and increased space (CAPEX)
  - Higher power consumption (OPEX)
  - Higher air velocities = increased noise levels
  - Unpredictable cooling can lead to hot spots
- Remove heat at the source – Row, Rack, Chassis
- Passive Rear Door Heat Exchangers (RDHx)
  - Cost effective
  - Increases cooling efficiency for a greener approach
  - Easy to deploy in Retrofits or new DC builds
  - Scalable – add only when you need it

Traditional Air-cooling System



Coolcentric System Overview



- Passive RDHx – no fans, no moving parts, no power, no noise
- Equipment-ejected exhaust air passes through coil and is cooled before exiting the RDHx
- Chilled water used above dew point (no condensate)
- Heat is removed from room through return water connection

Syracuse University Case Study

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- IT requirements growing faster than existing facilities could handle
  - Syracuse was faced with a decision - retrofit existing DC or build new 650kW DC
  - Existing DC infrastructure was “tired” - old, inefficient and hard to retrofit
- Syracuse University Options
  - Add more white space – band-aid solution, didn’t address core cooling issues
  - Add additional perimeter Computer Room Air Conditioners (CRAC) – more space, more power and delivery system inefficient
  - Add new In-Row Cooling devices – more space, more power
  - Incorporate aisle containment – inflexible, still using old CRAC
- Environmental and social responsibility commitment
  - Energy efficiency is a top priority to Syracuse – low PUE
  - Green DC
  - Retrofit options could not attain energy objectives
- The decision was made to build a new data center using RDHx as the primary cooling topology

Syracuse University Case Study

- Syracuse was able to achieve their goals
  - Most energy-efficient, green DC
  - 50% less energy consumption
  - Successful deployment of Trigeneration system, gas-powered micro turbines, chilled water RDHx
- Passive RDHx provide the primary cooling and only one CRAC is used for make-up air and humidification control
- RDHx were chosen because they consume minimal floor space, consume no power at the rack and help reduce energy consumption

http://www.syr.edu/greendatacenter/

Purdue University Case Study

- Rosen Center for Advanced Computing
  - High performance computing and storage DC
  - Used for advanced, cutting-edge science, engineering and research
- Historical building with DC in basement
  - Never intended to support an IT infrastructure
  - No raised floor, limited ceiling height = no flexibility and high noise levels
  - The 500kW limit was now stretched to the limit by new requirements
- No more available White space
  - Due to power, cooling and chilled water capacity constraints the data center was configured with partially populated racks with light load densities. The "spreading of the load" had reached maximum space utilization
  - No room for additional CRAC nor did Purdue want to continue to use CRAC
  - Active Fan Doors were tested as a space saving alternative
- Purdue University Options
  - Fully deploy active fan door
  - Build a new $60 million DC
  - Deploy liquid cooling in the form of the close coupled passive RDHx

Purdue University Case Study

- Purdue decision
  - Active fan doors were judged to have low ROI, consumed excessive power for the cooling provided and added too much noise
  - The $60 million price tag for a new DC – money the University hadn't allocated
  - RDHx were judged to be the most economical and provide best cooling option

- Purdue reasons for using liquid cooled, passive RDHx:
  - Half of the CRACs could be turned off = less noise, less power
  - Remove heat at the source = ultimate aisle containment solution
  - Scalable solution – can quickly add RDHx when needed
  - Small footprint = space conserved
  - Eliminates CRAC single point of failure
  - Reduced chilled water plant load
  - Significant energy savings
  - Extended the useful life of existing DC

- DC retrofit costs ~ $1 million

RDHx Benefits

- Save Energy, Reduce carbon footprint
  - 90% less power draw than CRAC
- Increase Data Center Utilization & Capacity
  - Up to 5X more compute capacity (densify and fully populate racks)
- Save space (or free up space for expansion)
  - Up to 84% white space savings
- Remove heat at source = predictable cooling
- Eliminate air movement fans = reduce noise levels
- Lower capital expense & operating expense
  - Generates savings on Day One, with typical TCO payback of 1 year or better

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