Thermal Load Balancing

PlateSpin Orchestrate use case

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The Problem: Data Center Cooling

- Cooling is expensive
  - In a typical data center, more power is spent on cooling than on servers. Estimates range from 44%[1] to as high as 63%.[2]
- Cooling is unavoidable
  - 10% of racks have ambient temperatures of 75°F or higher at the air intake at the top of the rack. High temperatures are causes of decreased hardware reliability. Intermittent ghosts and outright hardware failures are three times more prevalent in the top third of racks than the bottom two-thirds.[3]
- Air conditioning units are critical to service availability
  - Servers can redline within 90 seconds of an AC unit failure.[4]

[1] See, Simon. *Is there a pathway to a Green Grid?* Sun, 2008 http://www.ibergrid.eu/2008/presentations/Dia%2013/4.pdf
[2] http://h20331.www2.hp.com/ERC/cache/438048-0-0-225-121.html
[3] Sullivan, Robert F., Ph.D. *Reducing Bypass Airflow Is Essential for Eliminating Hotspots.* Upsite Technologies http://www.42u.com/data-center-hot-spots.htm
[4] Sharma, Ratnesh et al. *Balance of Power: Dynamic Thermal Management for Internet Data Centers*. HP Labs, 2003 http://www.hpl.hp.com/techreports/2003/HPL-2003-5.pdf

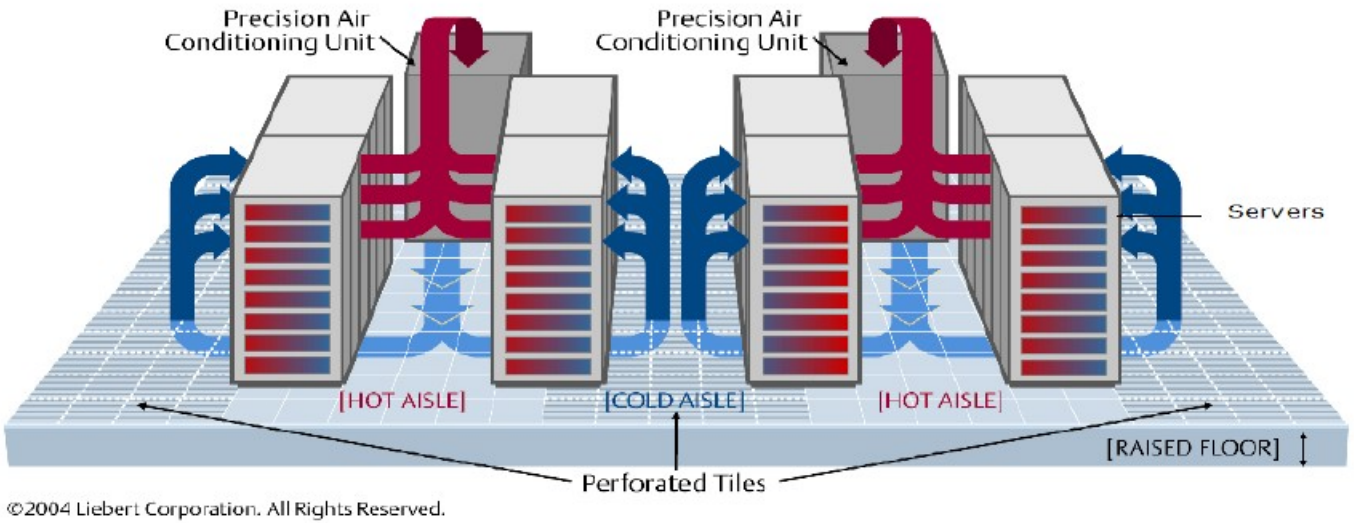
The Problem: Data Center Cooling (continued)

- Many data centers cool incorrectly
  - Cooling over-capacity is very common, and is not a predictor of successful cooling. In one study, nineteen rooms studied ran on average 2.7 times more cooling equipment than required to cool the computer heat load. Two rooms ran 16 times more cooling than required, yet one had 20% hot racks/cabinets and the other had 7% hot racks/cabinets.[1]
- There are over 80 energy efficiency incentive or rebate programs offered by local utilities or state energy efficiency programs in the US alone.[2]

[1] Sullivan, Robert F., Ph.D. *Reducing Bypass Airflow Is Essential for Eliminating Hotspots.* Upsite Technologies http://www.42u.com/data-center-hot-spots.htm
[2] *The green data center.* IBM, May 2007 http://www-900.ibm.com/cn/systems/migratetoibm/pdf/Energy-file03_OIW03002USEN.pdf

Existing solutions are limited

- Traditional raised floor cooling with alternating hot/cold aisles can typically only handle up to 5 kW per rack[1]
  - but rack power consumption can be in excess of 10kW
  - and the evolution of blade designs are causing density and power per rack to continually increase



[1] See, Simon. *Is there a pathway to a Green Grid?* Sun, 2008 http://www.ibergrid.eu/2008/presentations/Dia%2013/4.pdf

Existing solutions are costly

- Other solutions involve expensive, highly specialised thermal management, e.g.
  - pumped refrigerant coolant systems
  - hot air containment
    - per rack / per aisle
    - per data center! (“DC in a box”)
  - variable rate cooling units
  - sub-floor air pressure management
- Are there cheaper approaches?
- Can we **treat the cause** rather than the symptoms?
- What if we could do something *in software*?

A Novel (Novell®) Solution: Dynamic Thermal Load Balancing

- Virtualization and live migration allows dynamic relocation of workloads with no impact on service
  - Policy-based migration of VMs from hot spots to cool spots
- Energy consumption can be reduced by more than 14% by intelligent workload placement.[1]
- Risk of service outage due to computer room air conditioning unit failures can be mitigated by migrating workloads away from the failed unit.[1]
- Automatic VM live migration based on thermal policies can be implemented easily using PlateSpin® Orchestrate from Novell.

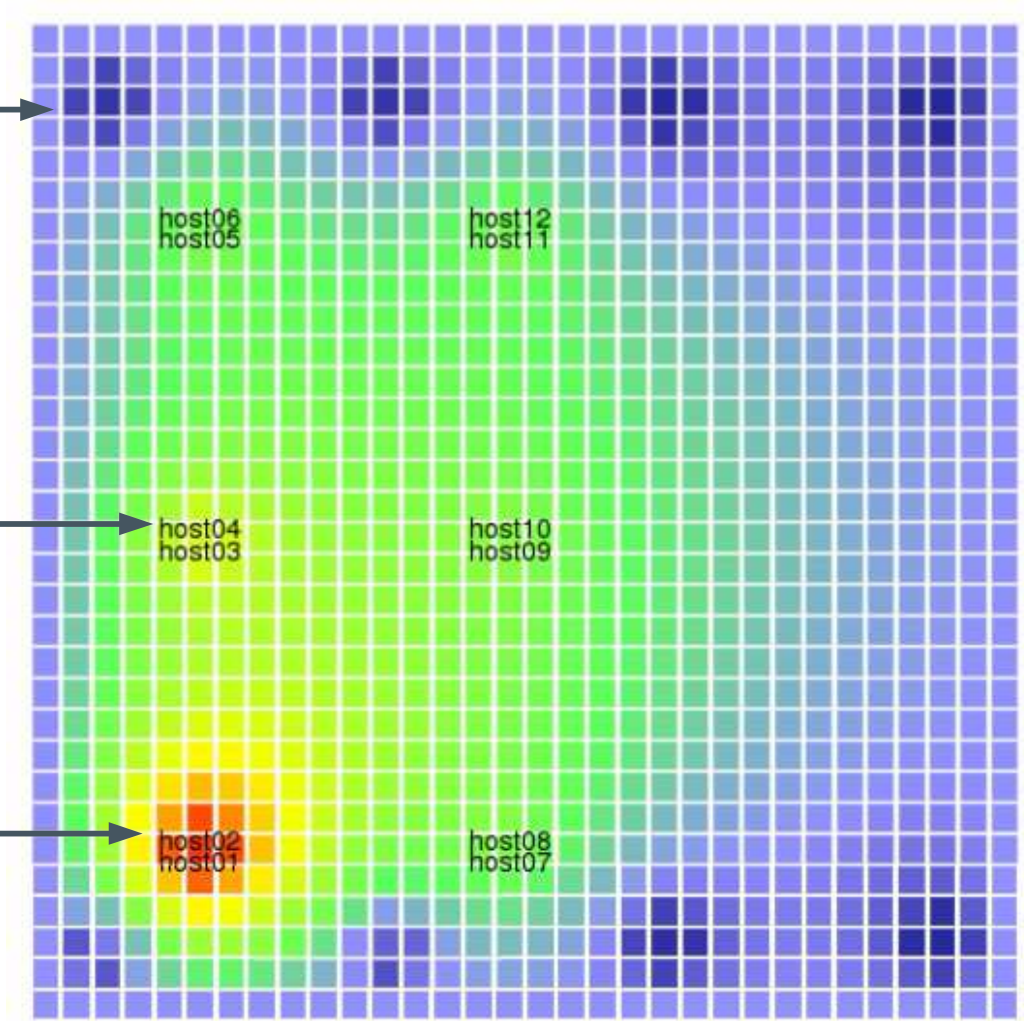
[1] Sharma, Ratnesh et al. *Balance of Power: Dynamic Thermal Management for Internet Data Centers*. HP Labs, 2003 http://www.hpl.hp.com/techreports/2003/HPL-2003-5.pdf

Thermal Load Balancing

Cooling Units

“Rack” of VM host hardware operating below capacity

VM host hardware operating at or near capacity

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