HP

Smart Data Centres

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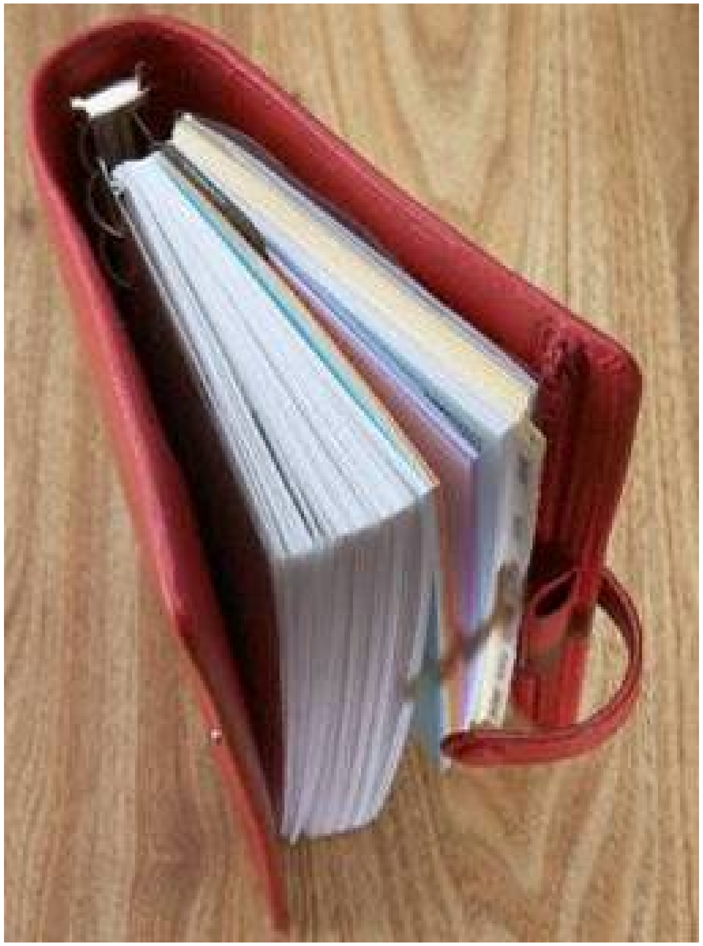
HP Services SEA

Content

- Data center drivers
- HP's holistic approach to power & cooling
- Data center power utilization
- HP Smart Data Center
  - Static Smart Cooling
  - Dynamic Smart Cooling



HP in Data Centre Technology

- Development of the next generation smart data centre started in 1998 by HP Labs
- Collaboration work in 2000 on supplementary cooling systems for high density server racks with Emerson (now known as the XD series)
- Voting Member ASHRAE TC9.9 Committee - ASHRAE TC9.9
- Use of computational fluid dynamic analysis (CFD) to analyse data centre cooling –" Smart Cooling " Thermal Analysis -2002

Data Center Thermal Analysis Service – Static Smart Cooling

- Introduced CFD modelling as a service in 2003 (U.S.) and 2004 (Asia) computational fluid dynamic analysis (CFD)
- Developed to help customers thermally manage their data centers
  - Statically provision cooling resources for effective cooling
  - Optimize cooling for energy savings

Facilities & IT: A new level of dialog

- Fact 1: Data center power density up 10x in the last 10 years
  - 2.1kW/rack (1992); 14kW/rack (2006)
- Fact 2: Increasing processor power
  - Moore's law confronting the laws of physics
- Fact 3: Energy costs going up
  - 3-year energy cost roughly equivalent to acquisition cost (U.S.); in Europe, it could be as high as 2X
  - Larger proportion of IT spend dedicated to energy
- Fact 4: Iterative power life cycle
  - Can take as much power to cool the heat generated from a system as it takes to power the system

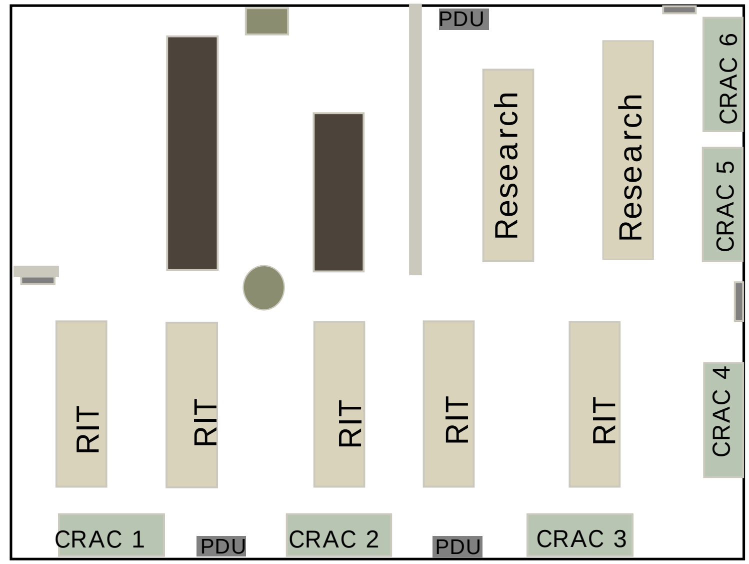
Data centers today

Data center drivers

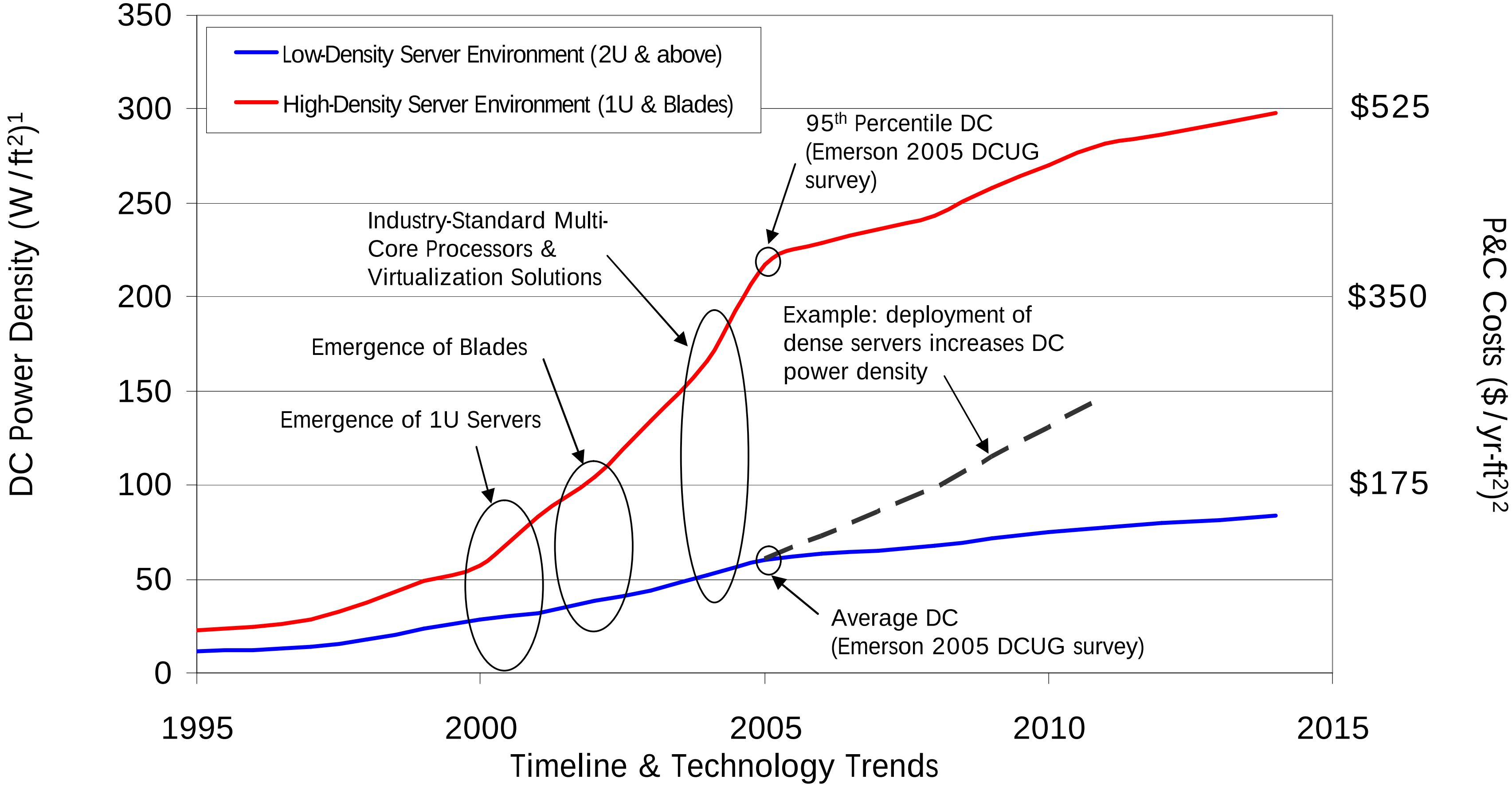
- Compaction & virtualization
- Improved uptime
- Lower operational costs
- Limited power capacity

Limitations in the state of art

- Data center design by intuition and “rules of thumb” cannot support the high power density (>1000 W/m^2).
- Current data centers lack control resulting in high operational energy expense.
- High personnel cost due to complexity and lack of automation.
- Inflexible components, over-provisioned



Power &Cooling is increasingly limiting scalability of the data center and driving up cost



[1]Belady, C., Malone, C., "Data Center Power Projection to 2014", 2006 ITHERM, San Diego, CA (June 2006)

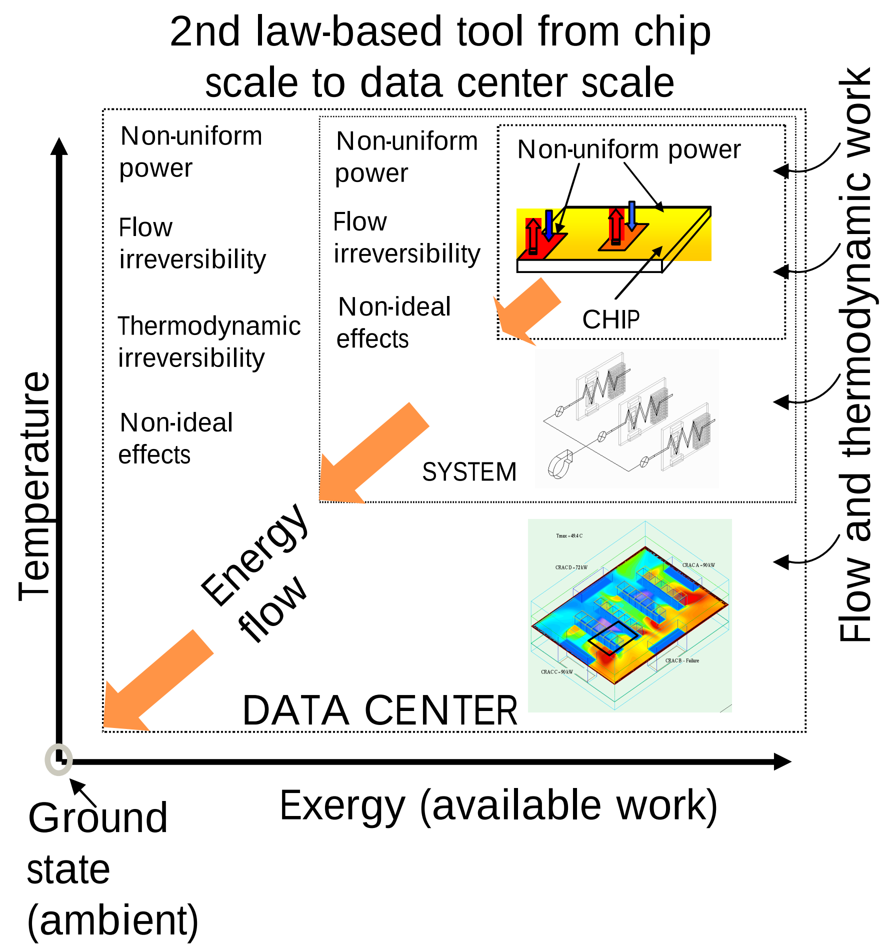
[2]1:1 ratio between IT & cooling power (IDC estimate) & electricity cost of $0.1/kW-hr

The effect of increasing density

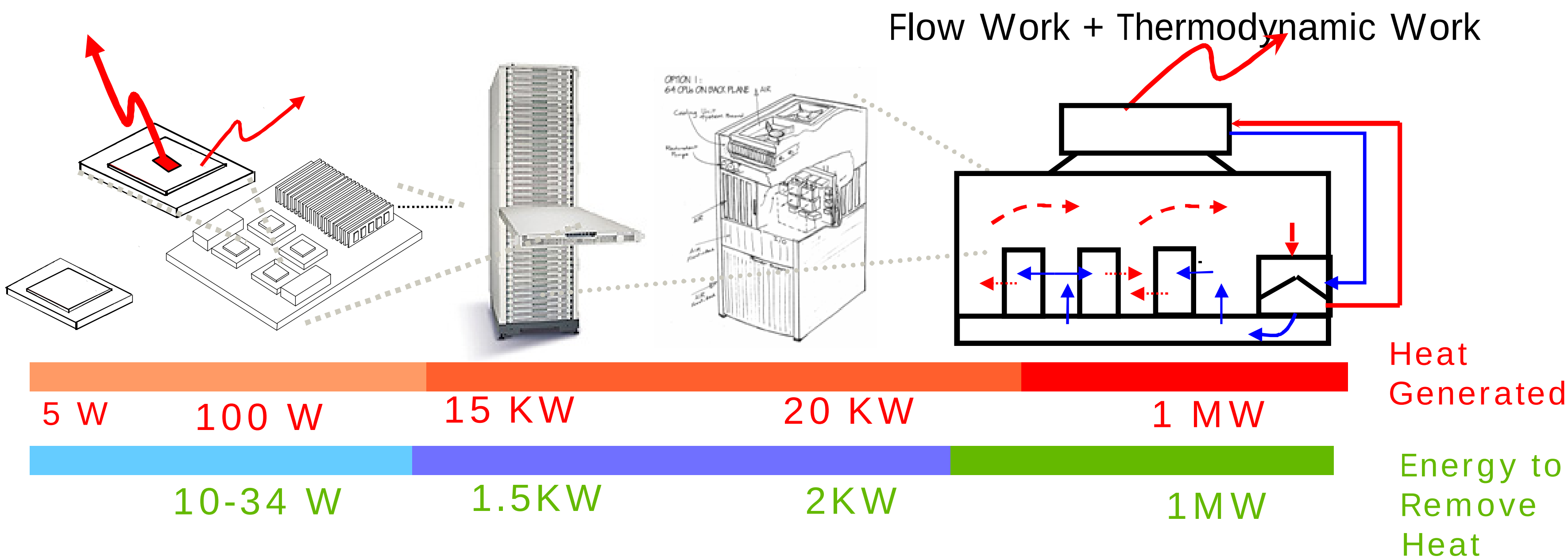
DL360 G1	DL360 G2	DL360 G3	DL360 G4	DL360 G5
204 W per Server	268 W per Server	417 W per Server	577 W per Server	622 W per Server
42 servers	32 servers	20 servers	15 servers	13 servers

Meeting the power & cooling challenge requires a holistic approach

- Complex problem
- Multi-layered challenge
- Interdependencies – standards-based approach
- Energy – finite resource



Cumulative effect on the data center



How does total data center power consumption break down?

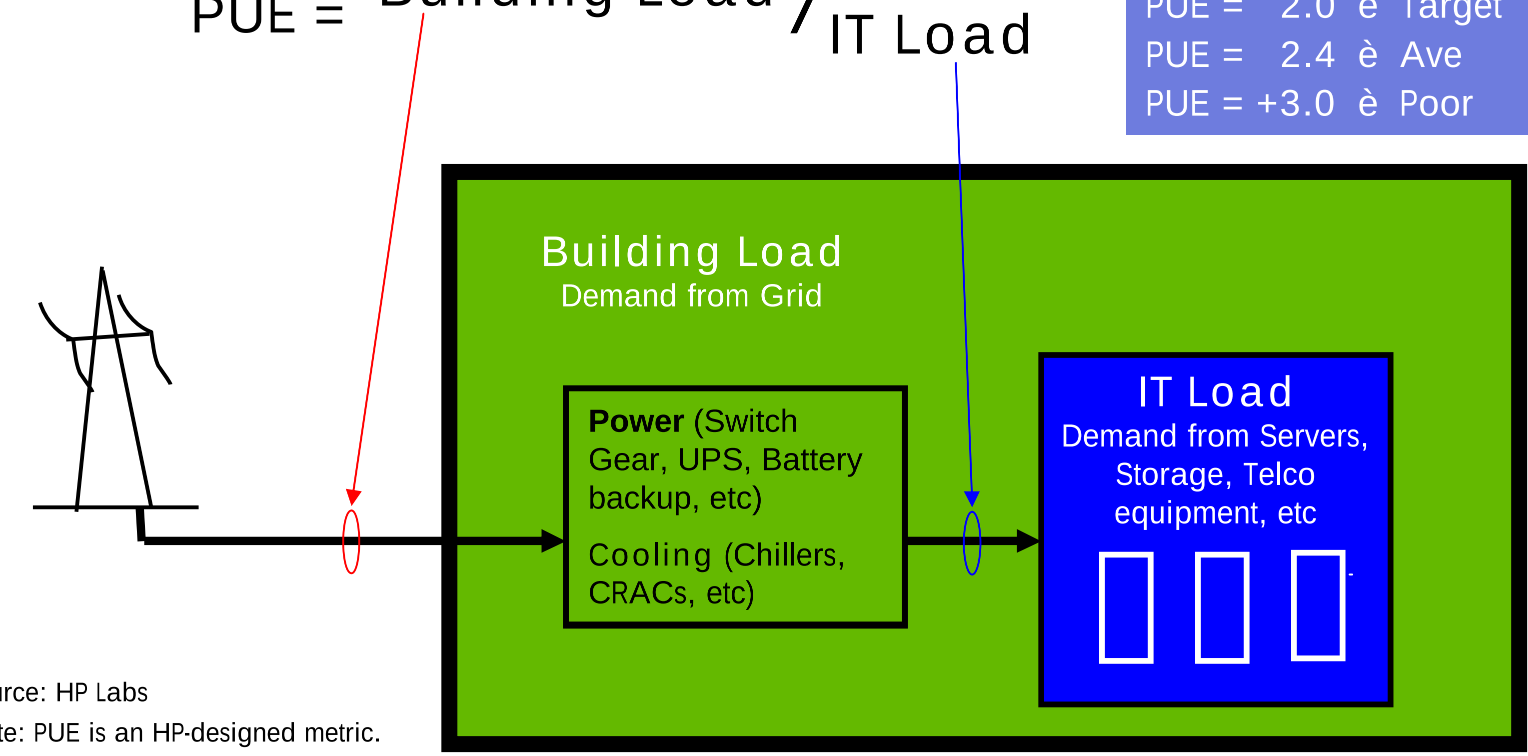
New way of looking at data center efficiency

Look at the ratio of building load to IT load as a measure of efficiency

- Introduce Power Usage Effectiveness (PUE) for the data center

PUE = Building Load / IT Load

Industry Numbers Suggest			
PUE = 1.6	è	Ideal	0%
PUE = 2.0	è	Target	5%
PUE = 2.4	è	Ave	10%
PUE = +3.0	è	Poor	85%

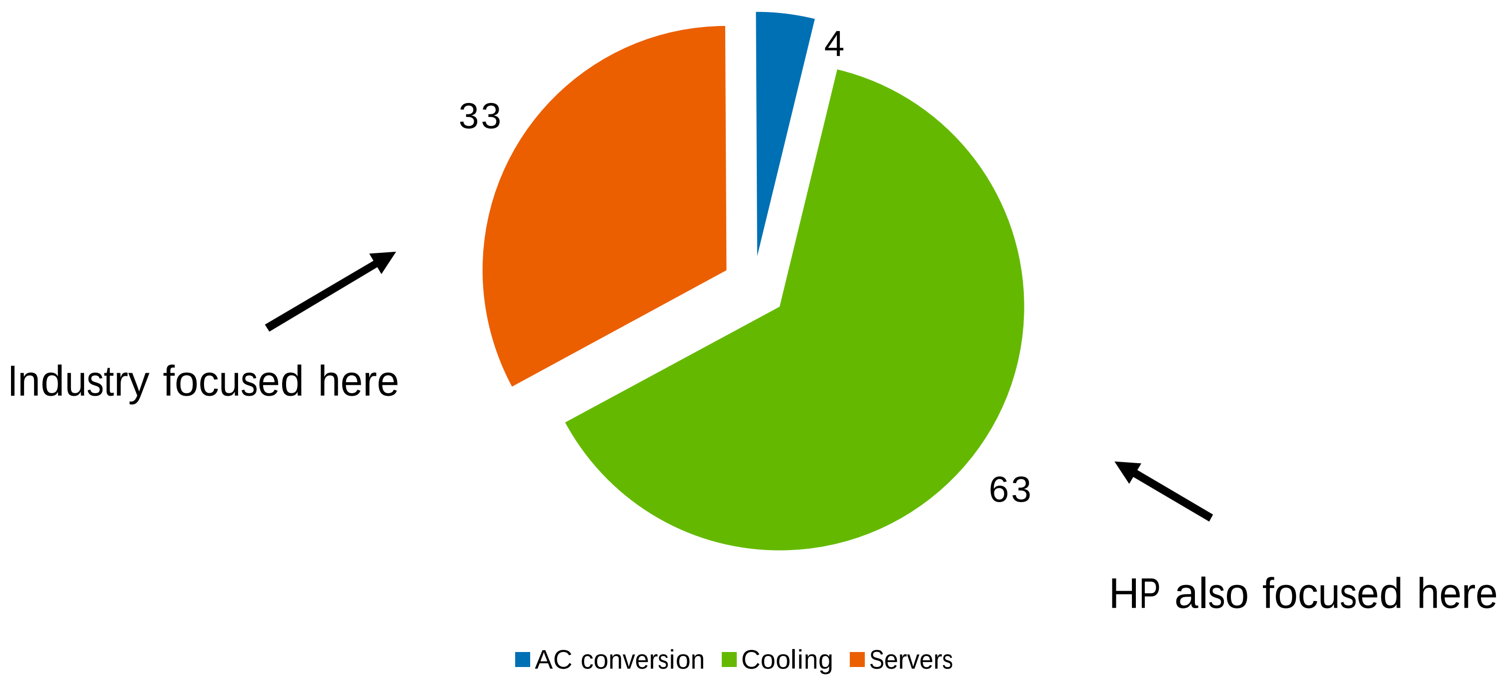


Source: HP Labs

Note: PUE is an HP-designed metric.

Cooling can represent 63% of data center power spend (over $10bn in 2005[2])

85% of the World's Data Centers[1]

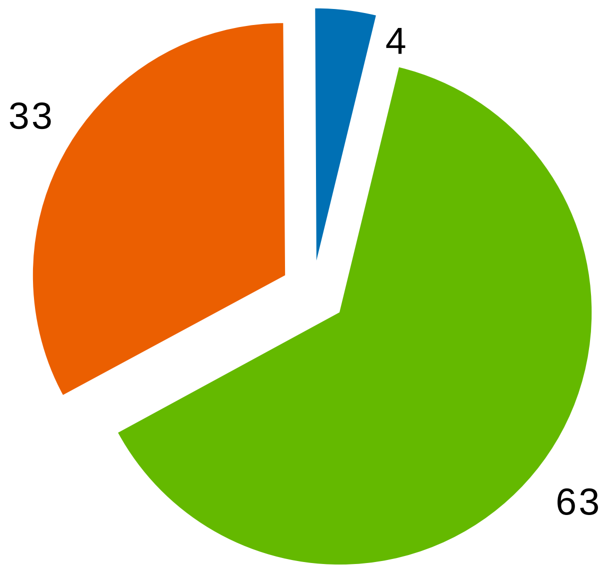


[1]Preliminary assessment from Uptime Institute

[2]Source: IDC Data Center of the Future US Server Power Spend for 2005 as a baseline ($6bn); applied a cooling factor of 1; applied a 0.6 multiplier to US data for WW amount

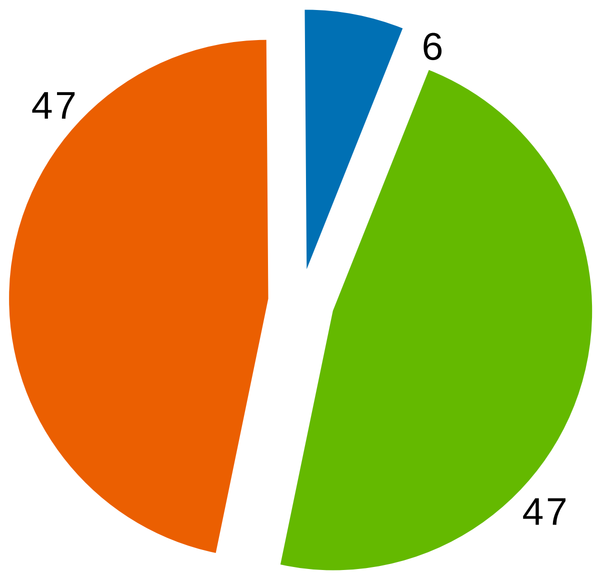
Optimizing PUE can increase available DC capacity or energy saving

85% of the World's Data Centers[1]



PUE = 3

New Data Center Following Best Practices[2]



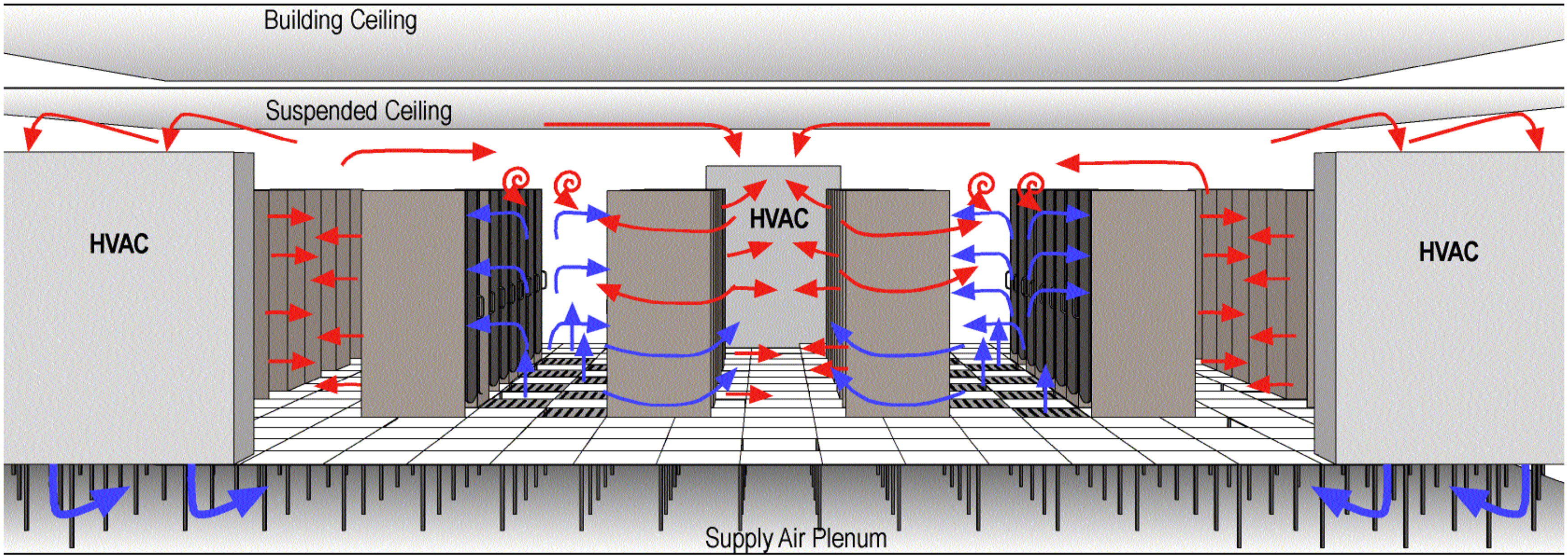
PUE = 2

■ AC conversion ■ Cooling ■ Servers

[1]Preliminary assessment from Uptime Institute

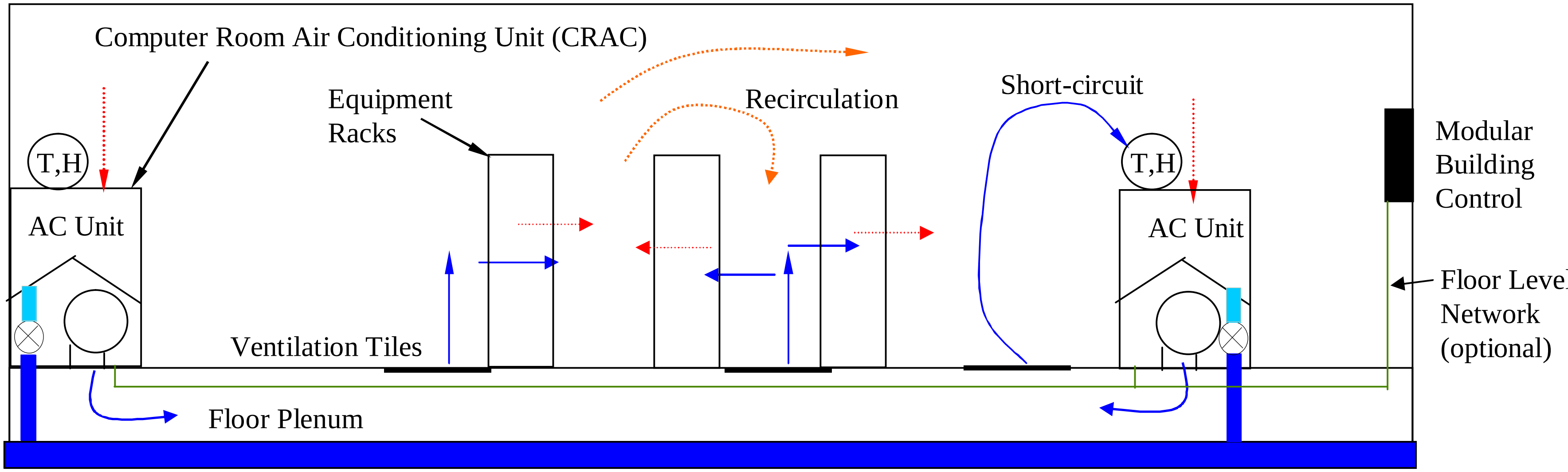
[2]IDC suggests a power-to-cooling ratio range between 1:1 and 1:0.5

Traditional data center cooling



- Hot aisle / cold aisle
- Ideal for up to 8-10 KW per rack
- Beyond 10KW per rack, alternative cooling solution is required

Challenges and limitations of typical data centers



- <u>Single-input single-output environmental control</u>
  - Lack of information about local conditions.
  - Re-circulation & short-circuiting of air flow
- <u>Responsiveness</u>
  - Location of control sensors promotes slow dynamic response (especially to ***local disturbances*** and ***dynamic workloads***)

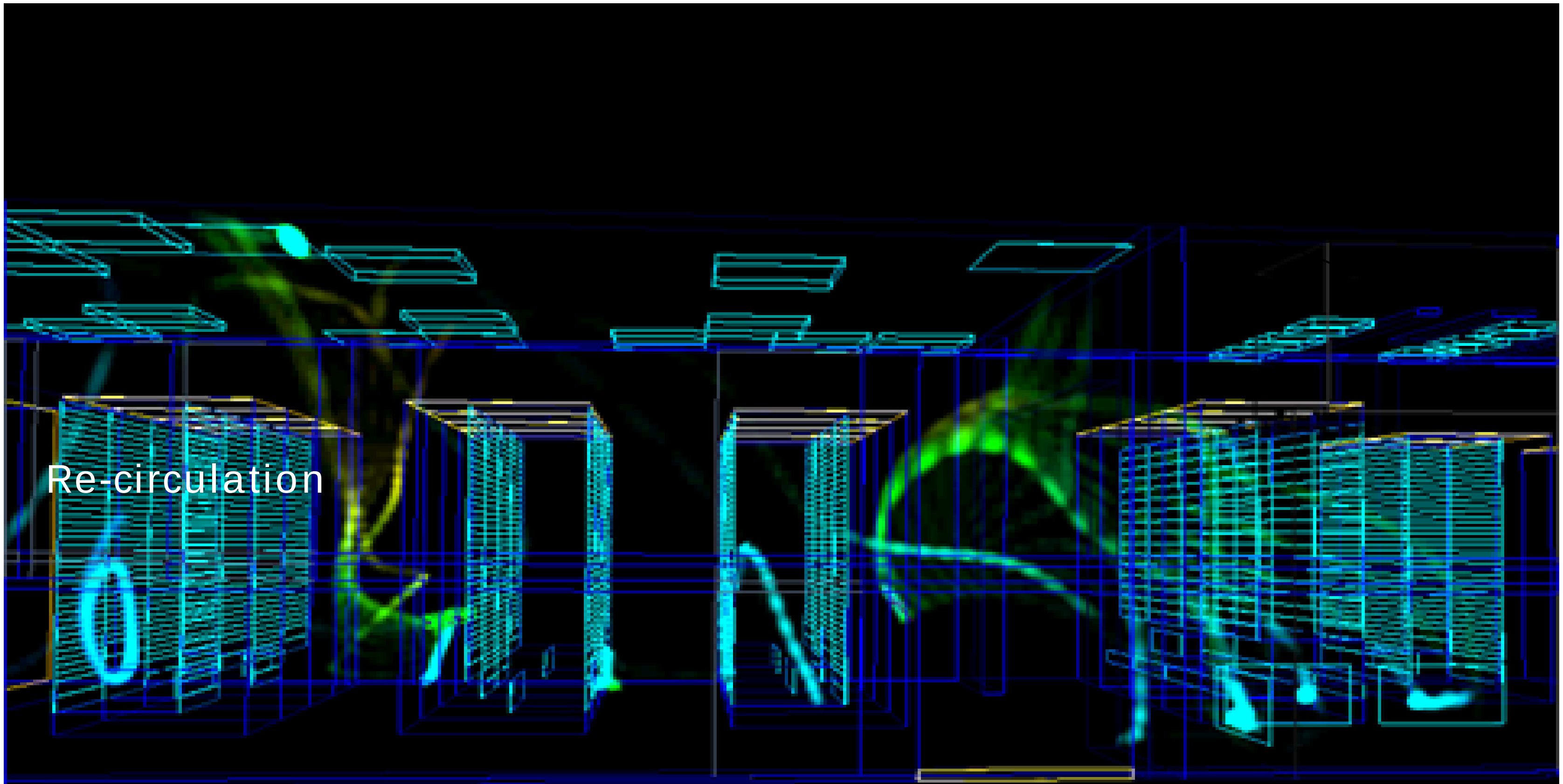
} Conservative operation

- <u>Energy Consumption</u>
  - Conservative operation leads to low Coefficients of Performance (often = 1)
  - $2.9 million per annum for a data center with 100 racks at 13 kW each

Poor Distribution of Cooling Resources

Example data center #1

Given layout of supply and returns will result in mal provisioning and “over” temperature issues



Excessive residence time of hot air particles, Inefficient air handling, AC mal provisioned

Data center best practices

1. Hot aisle / cold aisle
2. Matching server airflows
3. Eliminate gaps in rows
4. Use longer rows
5. Use blanking panels
6. Orient AC units perpendicular to hot aisles
7. Seal cable cutouts
8. Use 0.8m to 1.0m high floors
9. Separate high and low density areas
10. Use CFD modeling

Results in…

- Lower server temperatures
- Better reliability
- Better uptime
- Extends live of current data center
- Maximizes server density
- Decreased server temperatures increase the servers reliability
- Lower energy usage
- Lower TCO

HP Smart Data Center Solutions

Thermal Assessment Services

Quick wins and best practices for cooling savings and additional capacity

Sophisticated data center modeling using CFD to optimize cooling and eliminate hot spots while help to reduce cooling costs

Modular Cooling System

30 KW of cooling capacity for spot and high density deployments

A closely coupled cooling solution to maximize data center utilization

Dynamic Smart Cooling

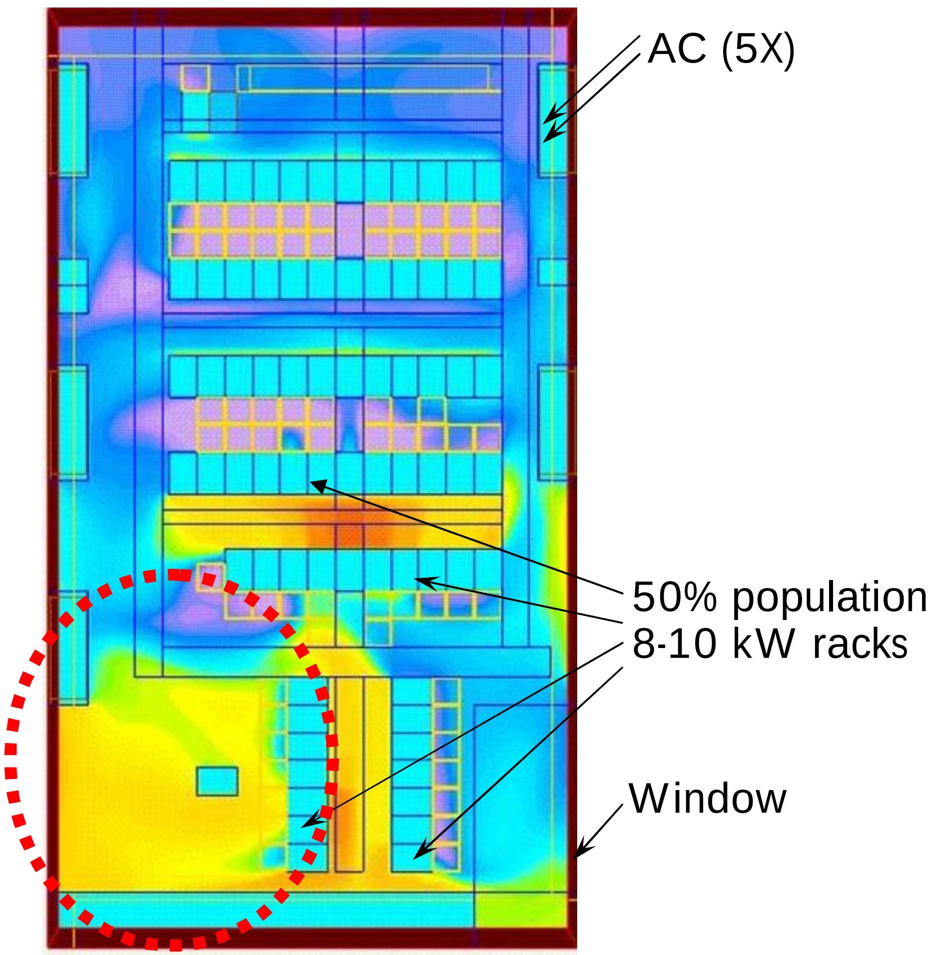
Positioned for enterprise data centers to maximizing cooling savings and data center capacity

Pervasive sensing and intelligent control of data center cooling. Integrated mgmt software uses advanced heuristics to dynamically adjust cooling resources

Static Smart Cooling
Customer Example

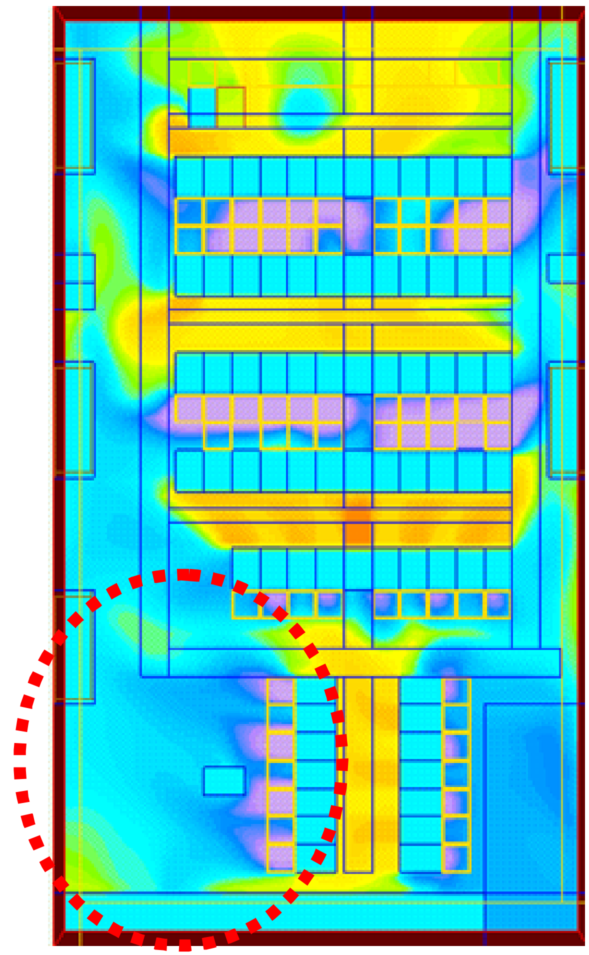
Initial Design:

- Uniform 150 W/ft^2 cooling
- Hot spots from dense distribution of 1U racks



HP Solution:

- CFD modeling to strategic repositioning inlet air vents - the only degree of freedom
- Equipment upgrades also considered



Source: Chandrakant Patel, HP

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Q & A

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