Managing Data Centre Heat Issues

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Managing Data Centre Heat Issues

- Thermal trends in the data centre

- Hot Aisle / Cold Aisle design & limitations

- 5 tips for improving existing data centers

- Planning for data centers

Why is thermal management MISSION CRITICAL?

- Data center heat loads are ever-increasing

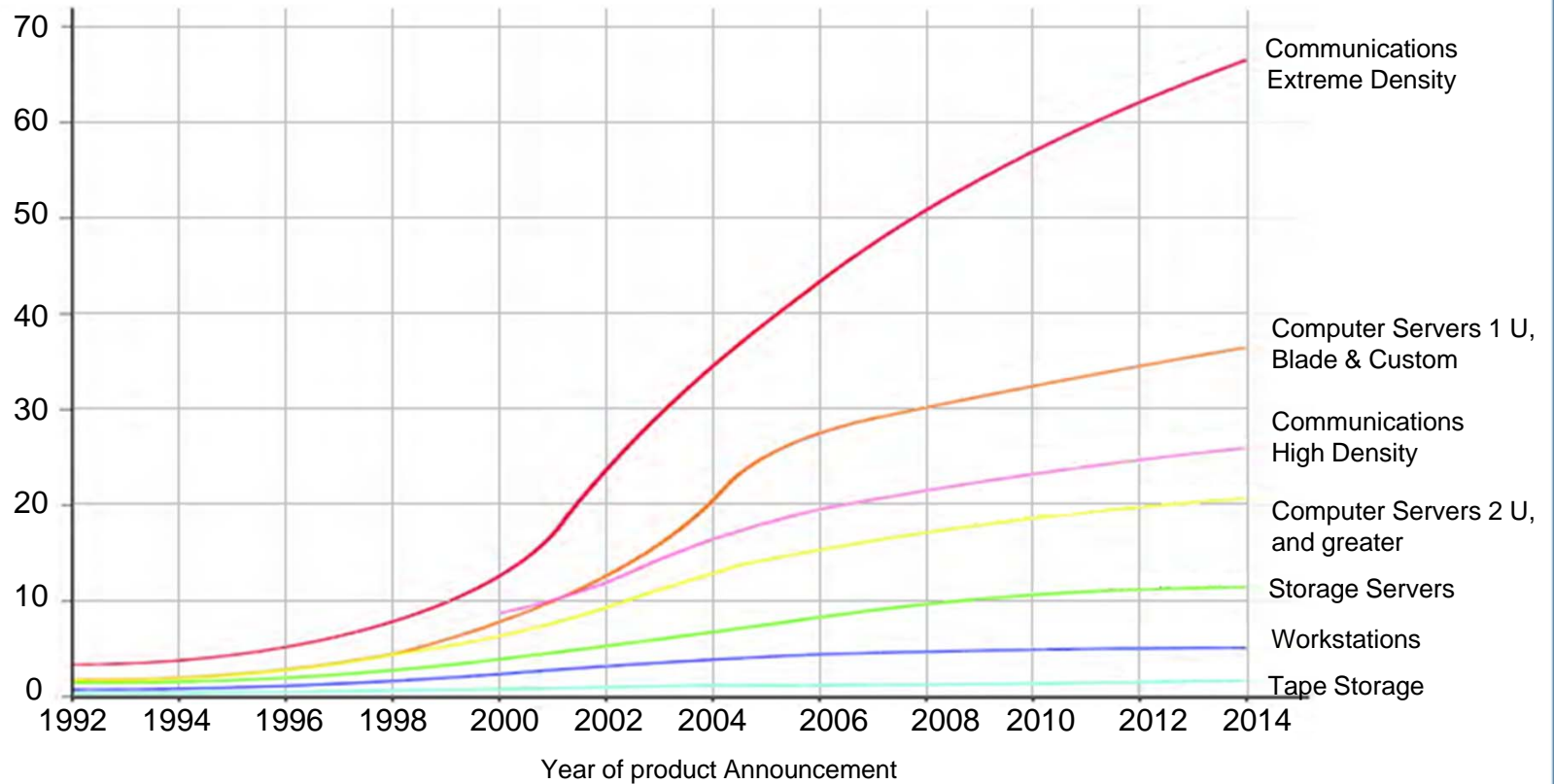- Skyrocketing energy costs are eating up IT and Facilities budgets
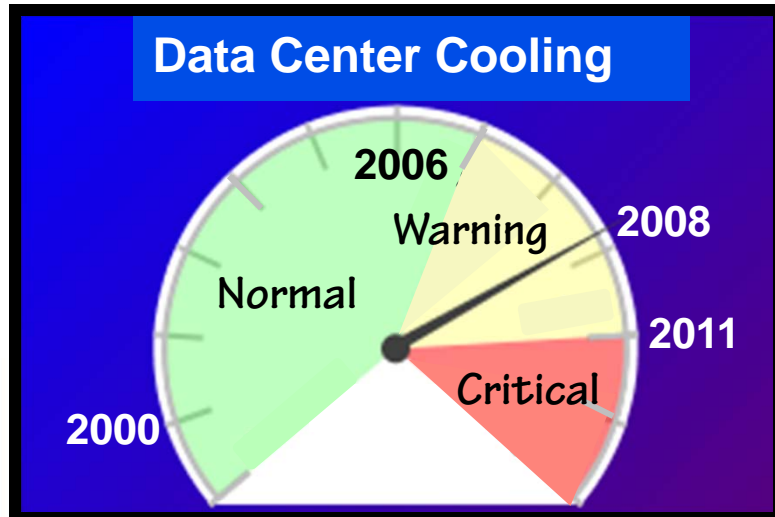
From 2000 to 2006, the total electricity consumption of data centers more than doubled.

It now represents an estimated 1.5 percent of the US total electricity use.

Source: Lawrence Berkeley National Laboratory

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Equipment Heat Load Trends

Heat Load in kW per rack (Based on cabinet footprint = 7 sq.ft)

Communications Extreme Density

Computer Servers 1 U, Blade & Custom

Communications High Density

Computer Servers 2 U, and greater

Storage Servers

Workstations

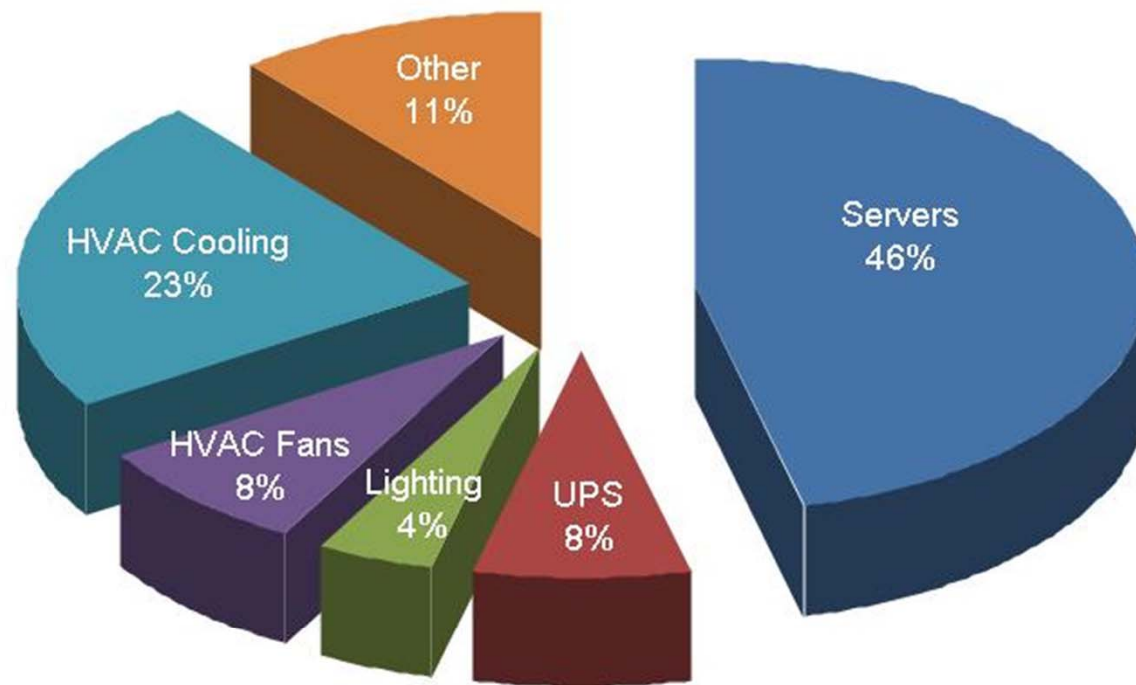Tape Storage

Year of product Announcement

"Datacom Equipment Power Trends and Cooling Applications"
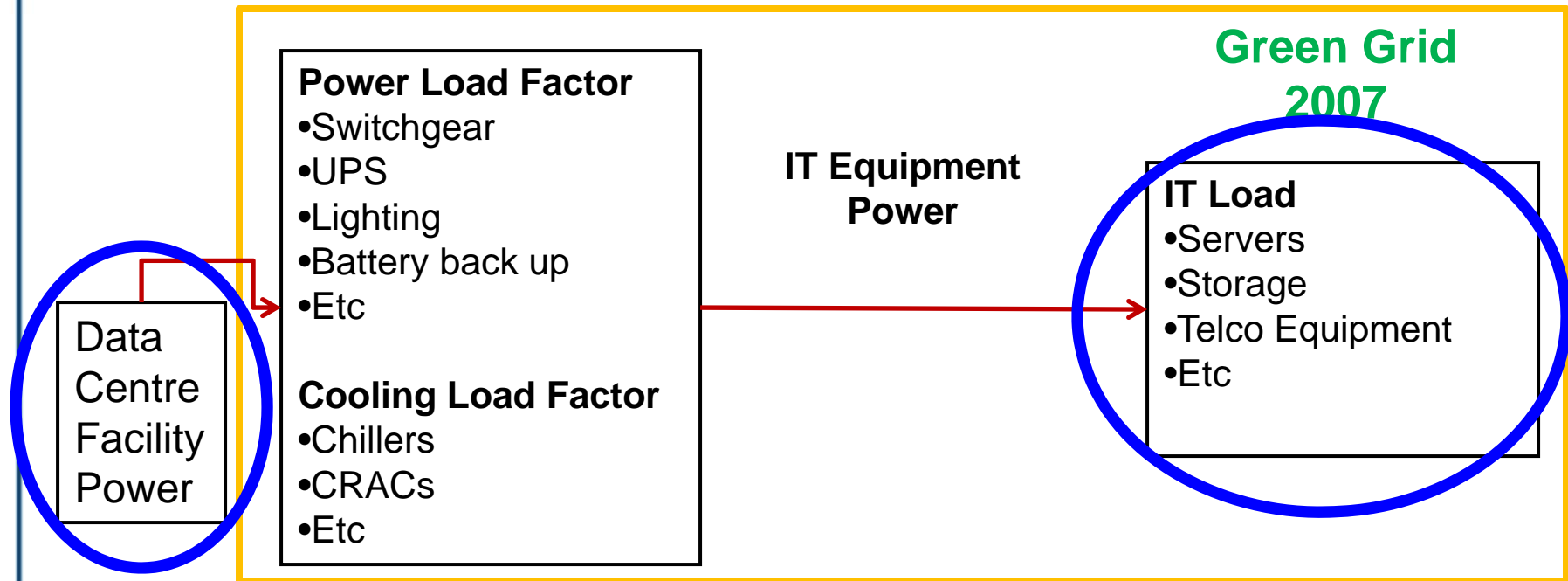©2005 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

Average Data Centre Power Allocation

Average power allocation for 12 benchmarked data centers (LBNL 2007a).

(PUE) Power Usage Effectiveness

Green Grid 2007

Power Load Factor
- Switchgear
- UPS
- Lighting
- Battery back up
- Etc

Cooling Load Factor
- Chillers
- CRACs
- Etc

Data Centre Facility Power

IT Equipment Power

IT Load
- Servers
- Storage
- Telco Equipment
- Etc

- $PUE = \dfrac{\text{Total Facility Power}}{\text{IT Equipment Power}}$

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Power Usage Effectiveness (PUE):

- 100% Utilization   =   1.0 (impossible!!!)
- Ideal PUE   =   1.6
- Target PUE   =   2.0
- Typical PUE   =   2.4 to 2.8 and higher

Higher PUE measurements represent higher
utility costs, due to poor mechanical efficiency

Mechanical Inefficiencies

Definition:

Bypass Airflow is when conditioned air is not getting to the intakes of the IT equipment

- Uptime Institute found that 30 + DCs the avg was 2.6 x over the normal cooling capacity

- 60% of the cool air cools the room but not the critical load except by recirculation

- Only 40% of cool air is supplied through cold aisle

With Bypass Airflow

CRAC
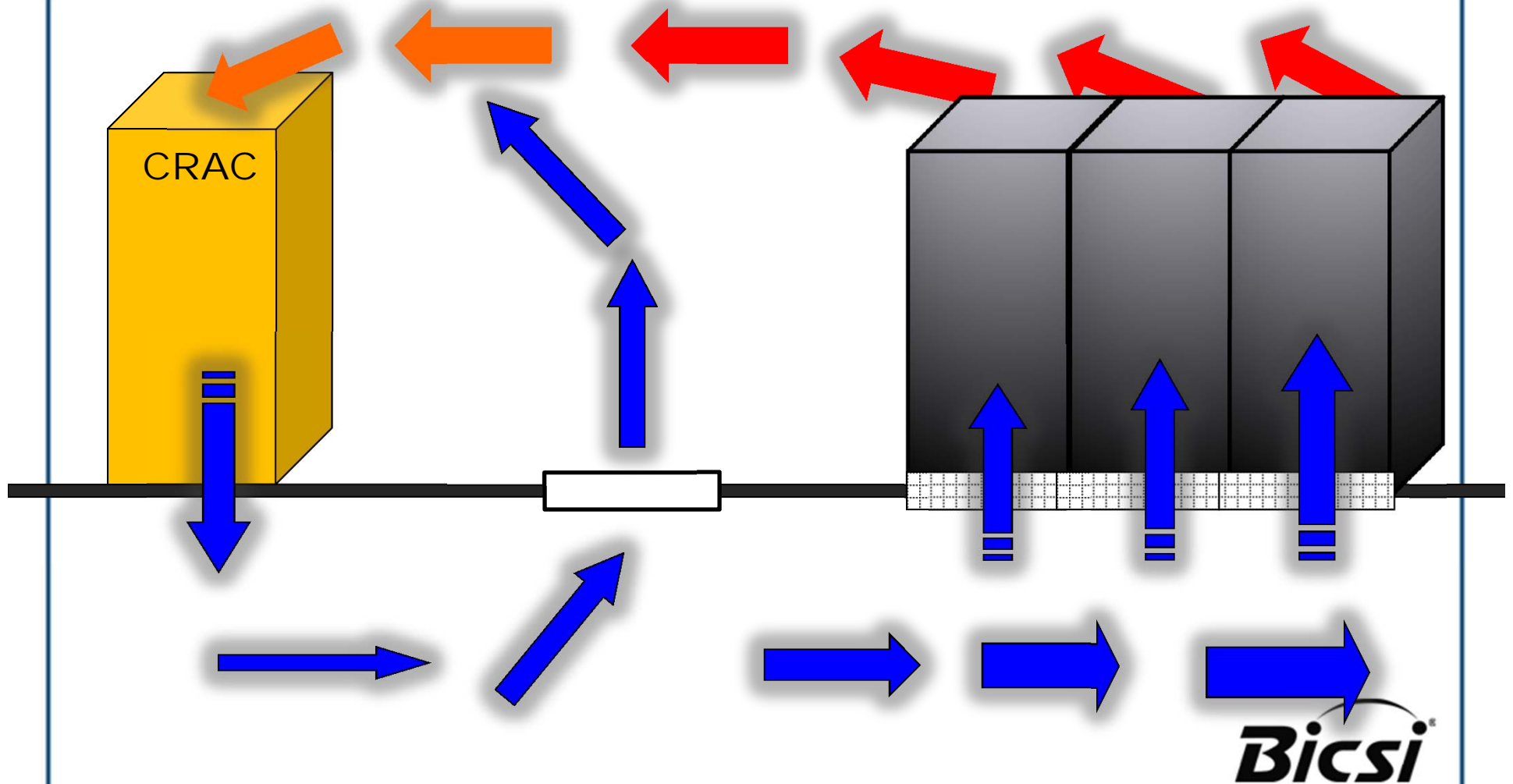
Zero Bypass Airflow
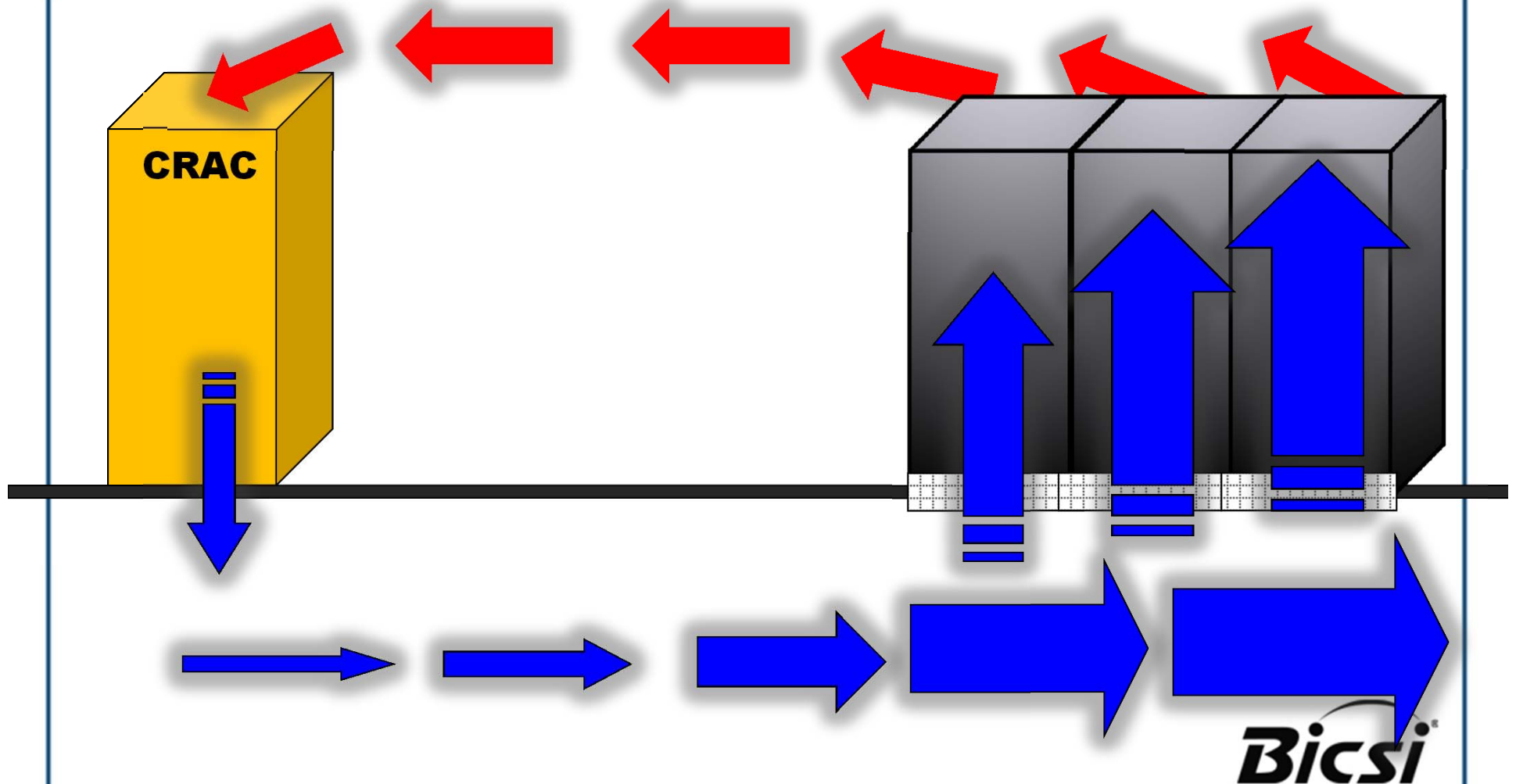
Thermal Trends in the Data Centre

IT Equipment input air temperature above 27ºC (80.6ºF) or outside 40% - 60% Rh is a…*

HOT SPOT!!

PROBLEM: going outside of this measurement means you cannot guarantee equipment reliability and performance!

*As per guidelines of ASHRAE

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New Trend = "Hot spots" in the cabinet
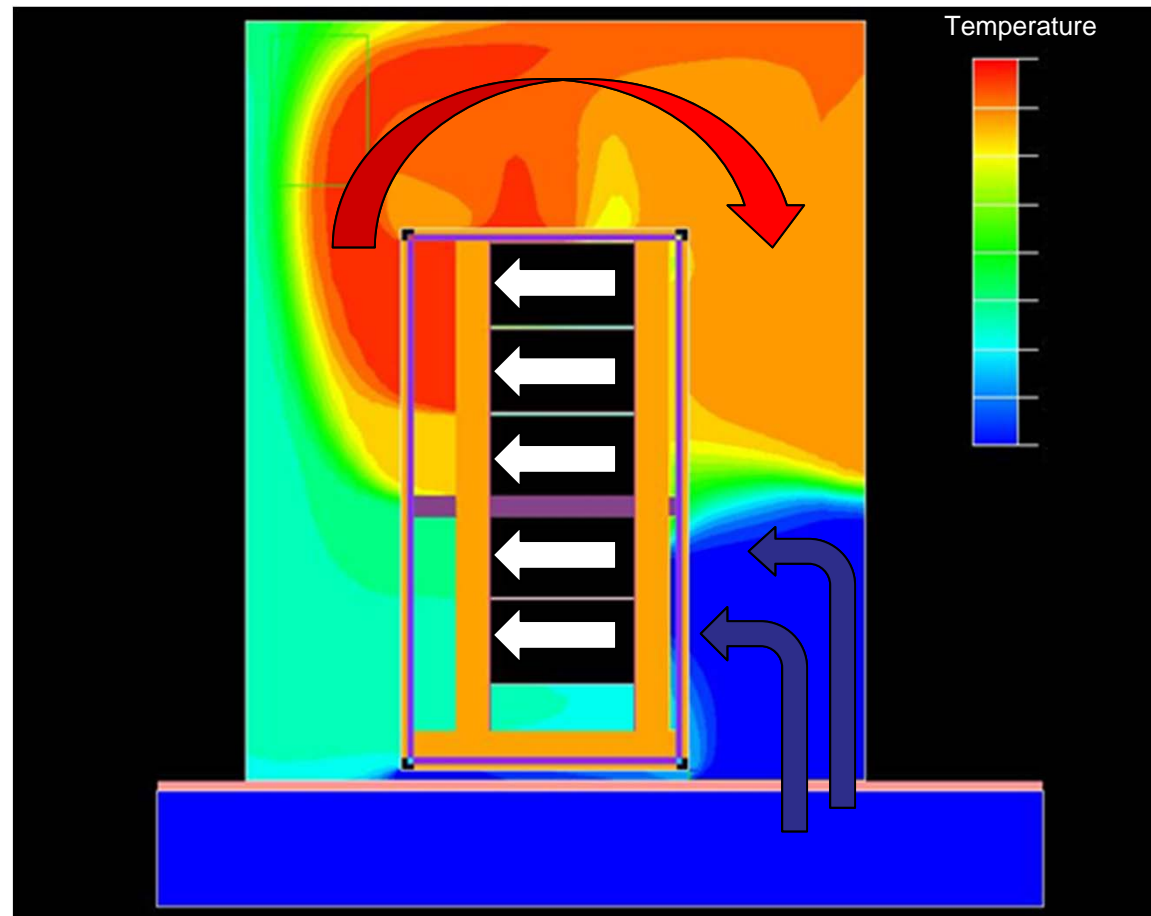
Thermal Trends in the Data Centre:
"Do I have a hot-spot?"

Strategically placed temperature strips can give a low cost visual reference

Use infrared thermometer to measure for hot spots – any point at air in-take over 27°C (80.6°F).

BICSI   Measure directly at server in-take
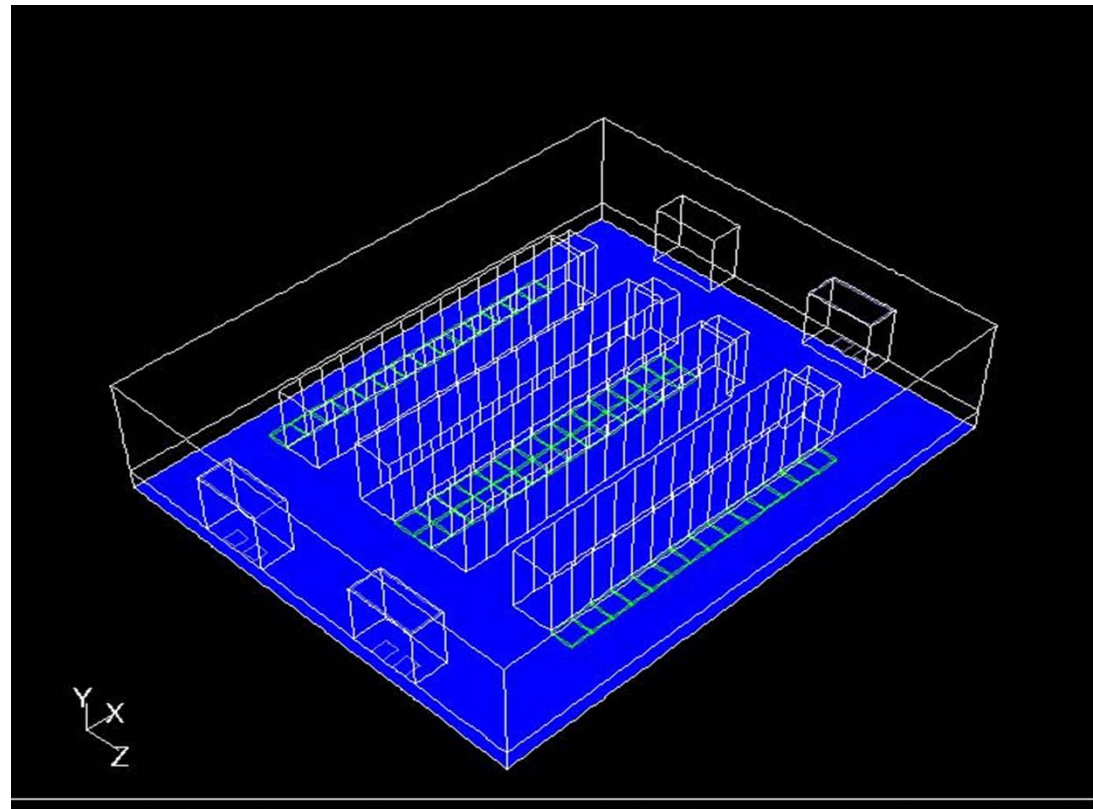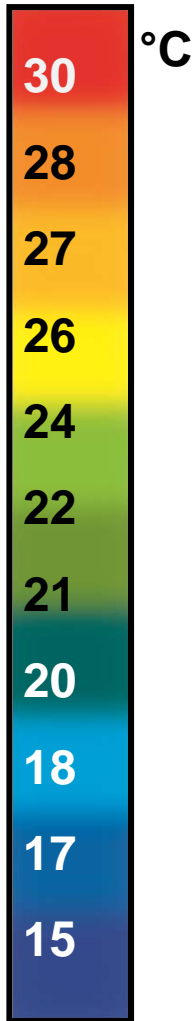
Managing Data Centre Heat Issues

- Thermal trends in the data centre

- **Hot Aisle / Cold Aisle design & limitations**
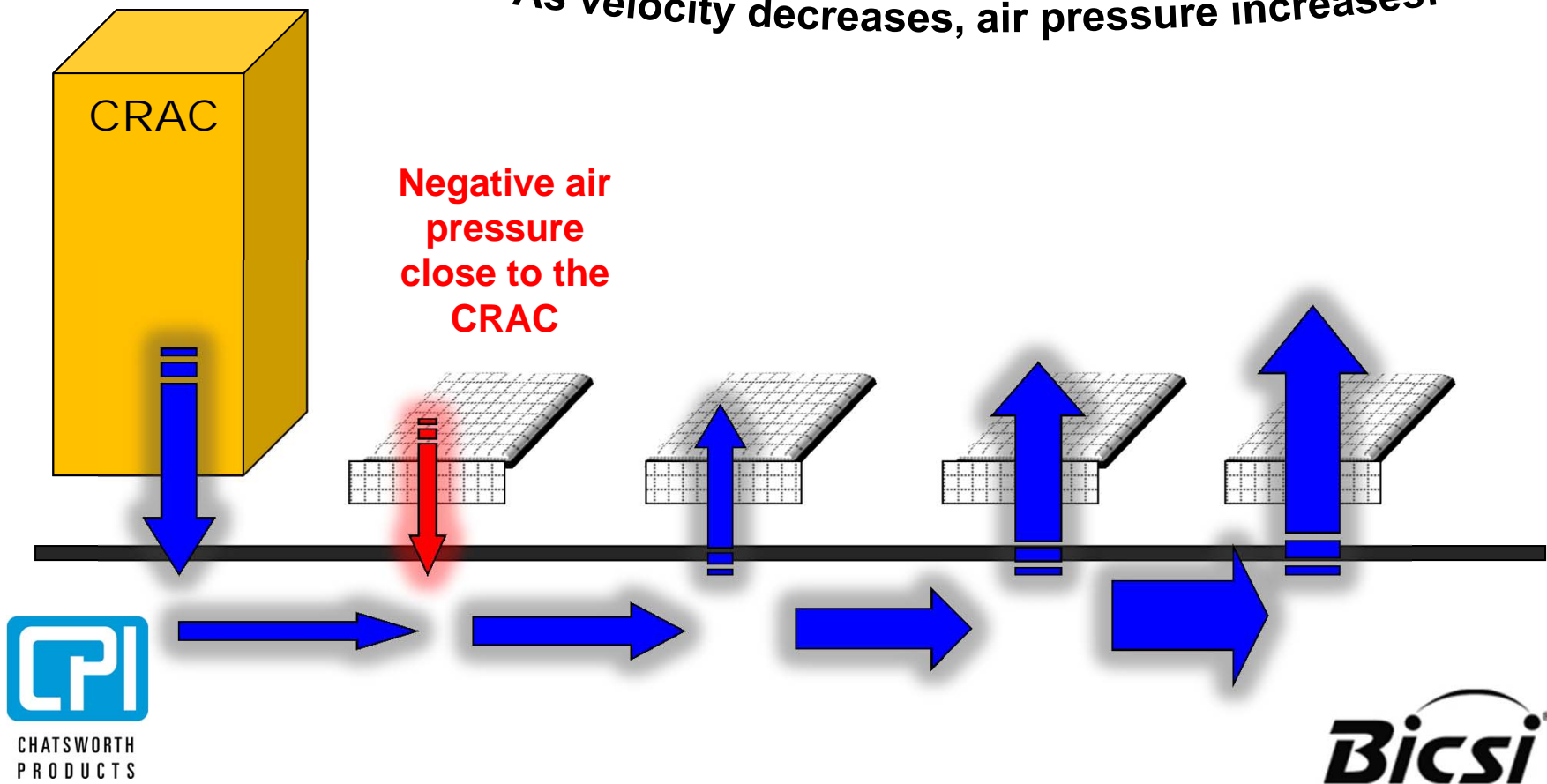
Hot Aisle / Cold Aisle Limitations

HOT AISLE   **COLD AISLE**   **HOT AISLE**   **COLD AISLE**
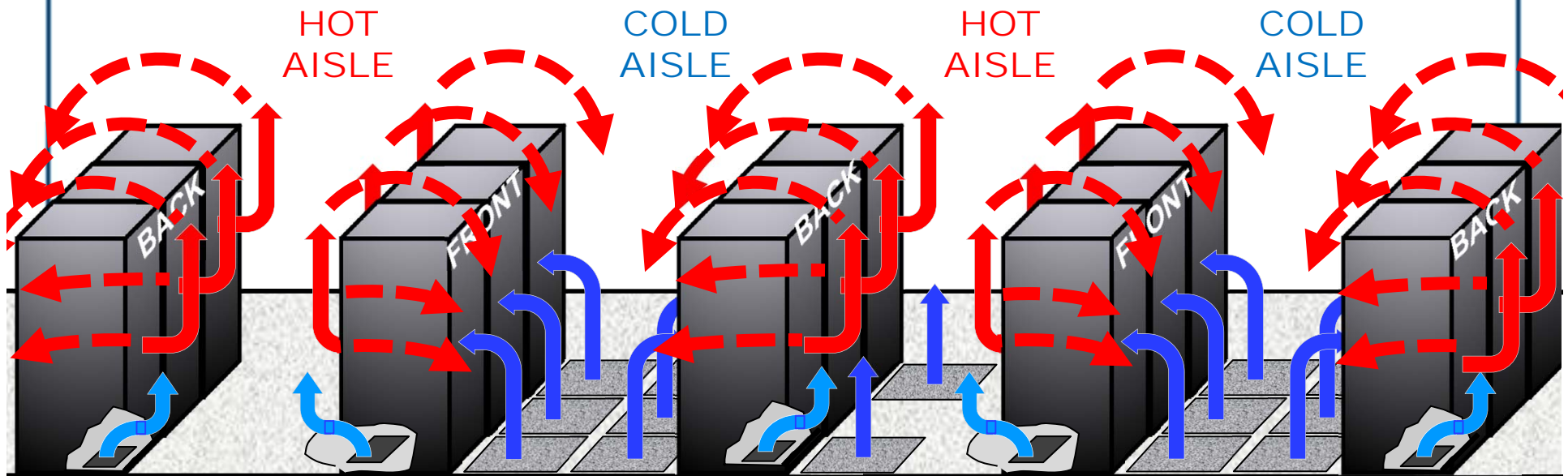
- **Hot Air recirculation from the hot aisle into the cold aisle**
- **Bypass airflow under the cabinets**
- **Spot the mistake?**

Hot Aisle / Cold Aisle Configuration

Hot Aisle / Cold Aisle Design: CRAC Airflow Reality

As velocity decreases, air pressure increases!

CRAC

Negative air pressure close to the CRAC

Managing Data Centre Heat Issues

- Thermal trends in the data centre

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- **5 tips for improving existing data centers**

5 Tips for Improving Existing Data Centre's

1. Perforated Metal Doors – Front and Rear

Perforated Metal Doors

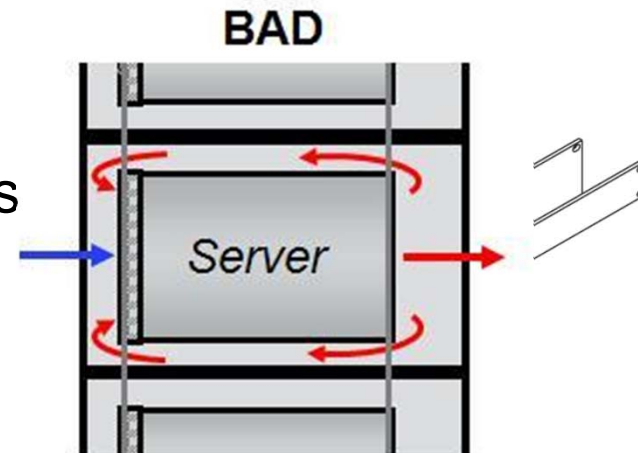- Allow airflow to enter equipment easily
- 63%+ perforation
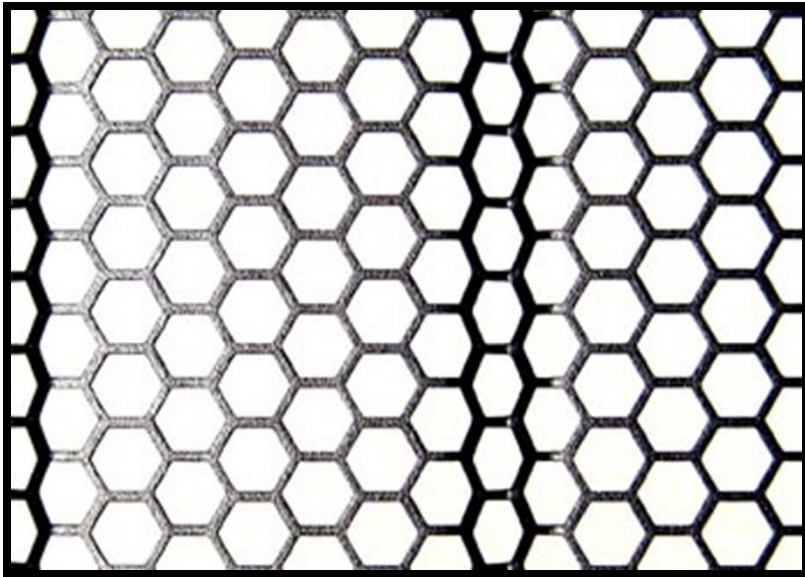
5 Tips for Improving Existing Data Centre's

1. Perforated Metal Doors – Front and Rear
2. **Use Filler Panels – to prevent recirculation**

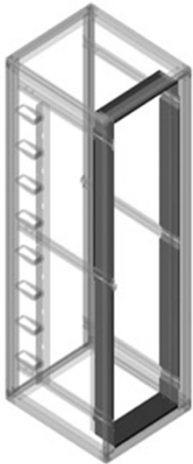# Use Filler Panels – to prevent recirculation

- Attach to equipment mounting rails

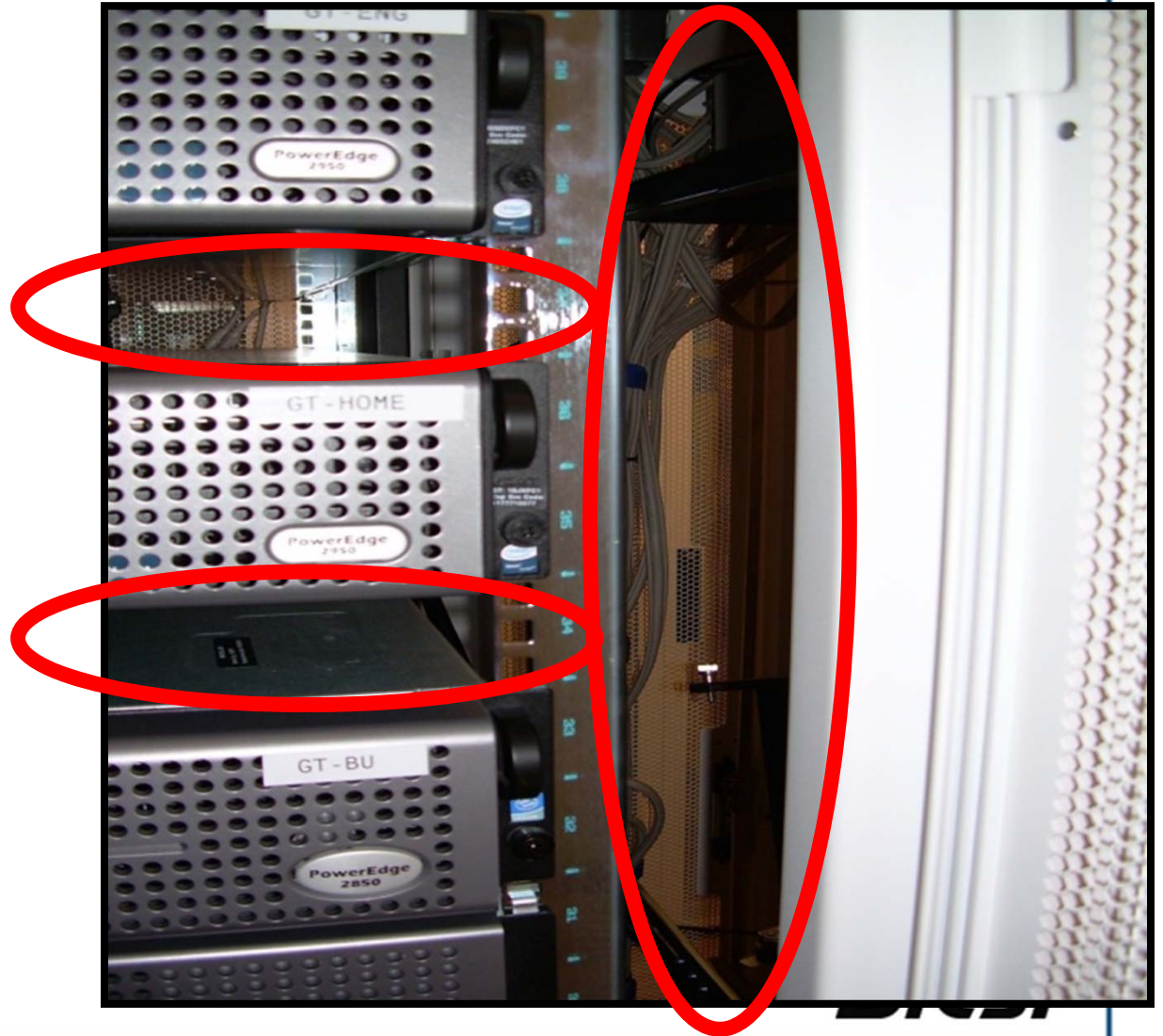- Prevents hot and cold air from mixing within the cabinet
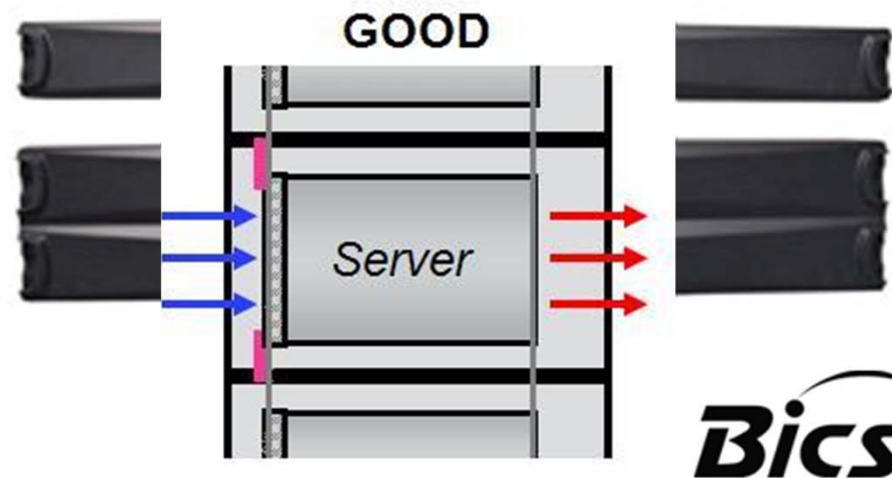
5 Tips for Improving Existing Data Centre's

1. Perforated Metal Doors – Front and Rear
2. Use Filler Panels – to prevent recirculation
3. **Internal Air Dams – to prevent recirculation**

- Air Dam Kit

- Filler Panels

5 Tips for Improving Existing Data Centre's

1. Perforated Metal Doors – Front and Rear
2. Internal Air Dams – to prevent recirculation
3. Use Filler Panels – to prevent recirculation
4. **Prevent Bypass Airflow**

Prevent Bypass Airflow

- Considerations
  - Ease of use?
  - Requires policing?
  - Fire Rated?
  - Particulates?
  - Retrofit-able?

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5 Tips for Improving Existing Data Centre's

1. Perforated Metal Doors – Front and Rear
2. Internal Air Dams – to prevent recirculation
3. Use Filler Panels – to prevent recirculation
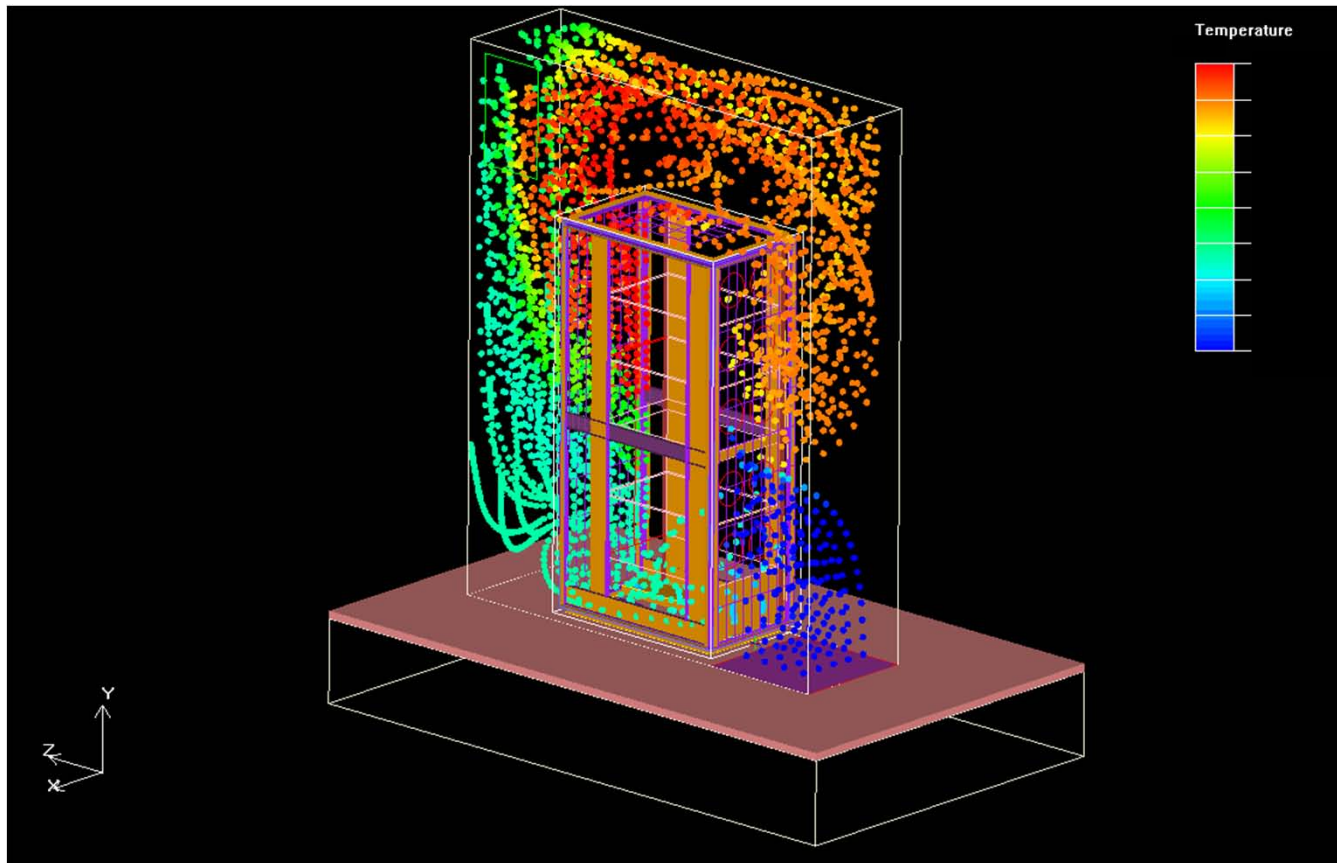4. Prevent Bypass Airflow
5. **Do Not Use Top-Mounted Fans**

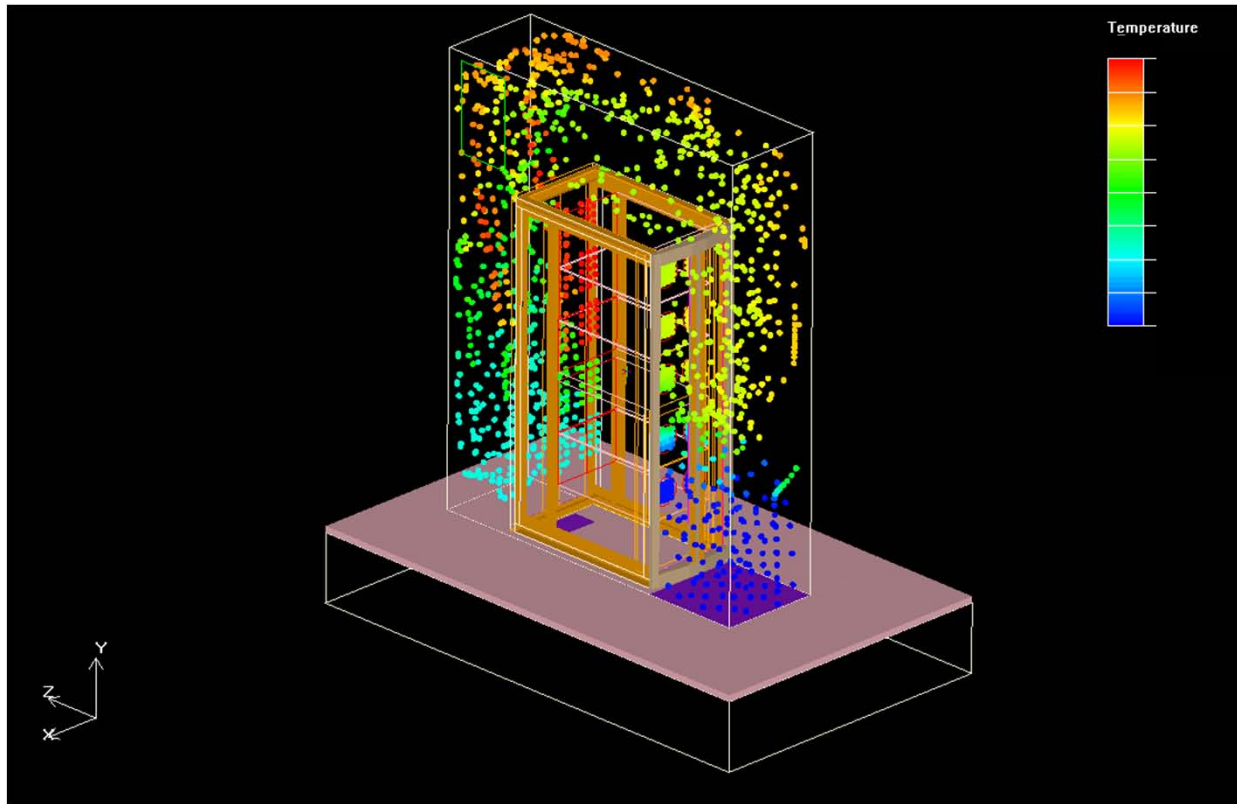# Managing Data Centre Heat Issues

Dell White Paper:

Rack Impacts on Cooling for High Density Servers

"The addition of rack fans or fan trays is not recommended. In some cases, additional top mounted rack fans have actually impeded server thermal performance."

Cabinet Fans Cause Hot Spots

Removal of Fans Reduces Cold Aisle Temperature

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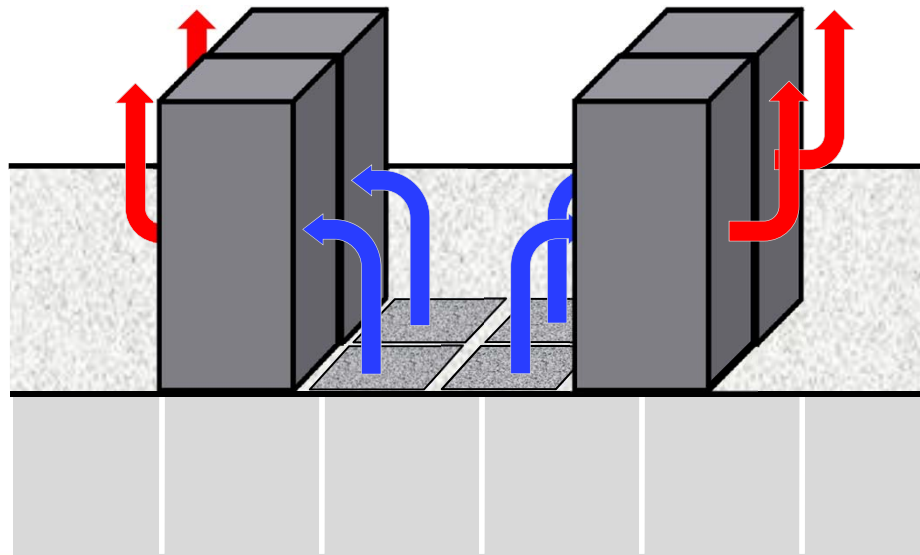
- **Planning for data centers**

Planning For Data Centre's
## A change of thinking . . .

Why is the cabinet important?

The cabinet is the **architectural feature** in the data centre **that secures** the **isolation** between supply air and return air

Planning For Data Centre's: Water Cooled Cabinets

Benefits

- Legacy Technology

- Cooled directly at the cabinet

- Not dependant on raised floor

- Can be scaled to kW cabinet load

- Isolates hot air from cool air

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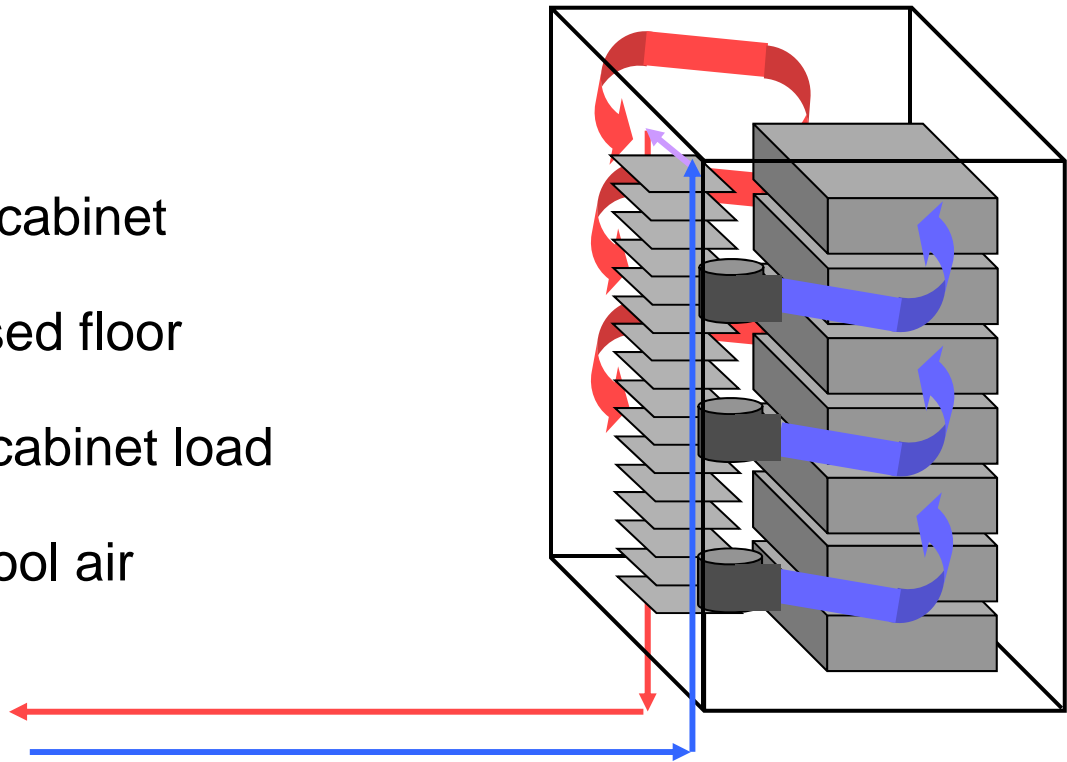
Planning For Data Centre's:
Water Cooled Cabinets

Negatives

- Complicated
- Multiplies the possible points of failure
- Lifespan on components = redundancy plan
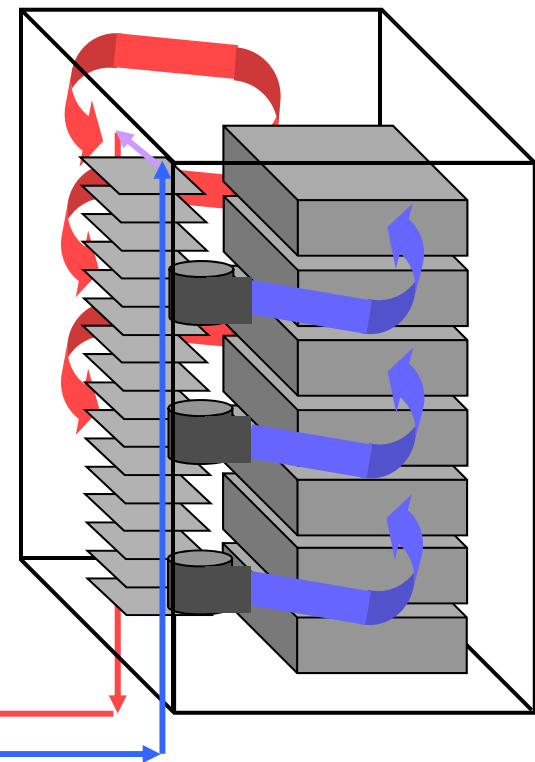- Coolant lines in data centre

Costly
- Both cabinets & construction costs
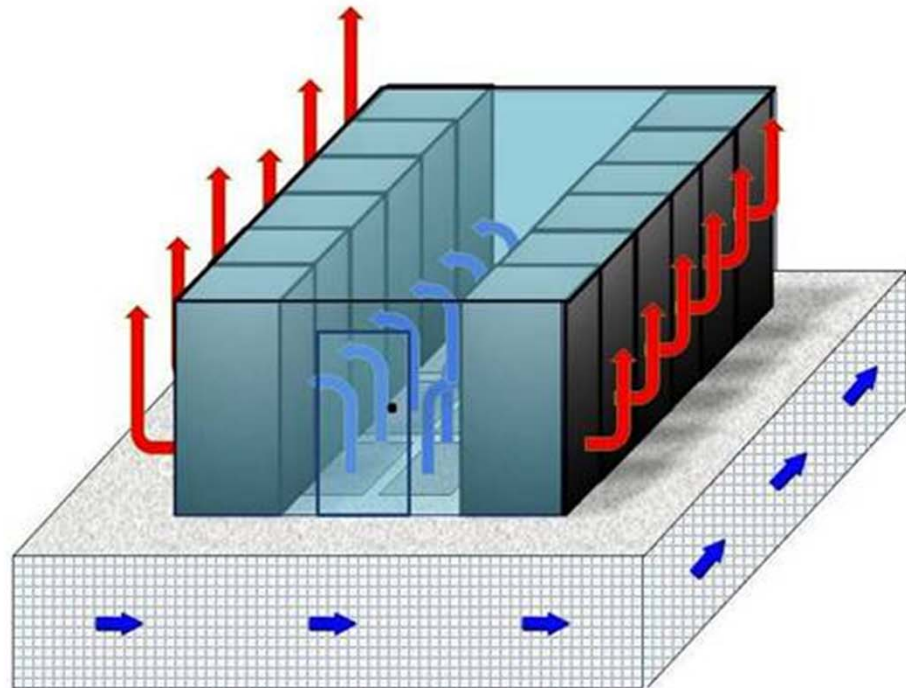- Operating costs

Size

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Planning For Data Centre's:
Cold Aisle Containment
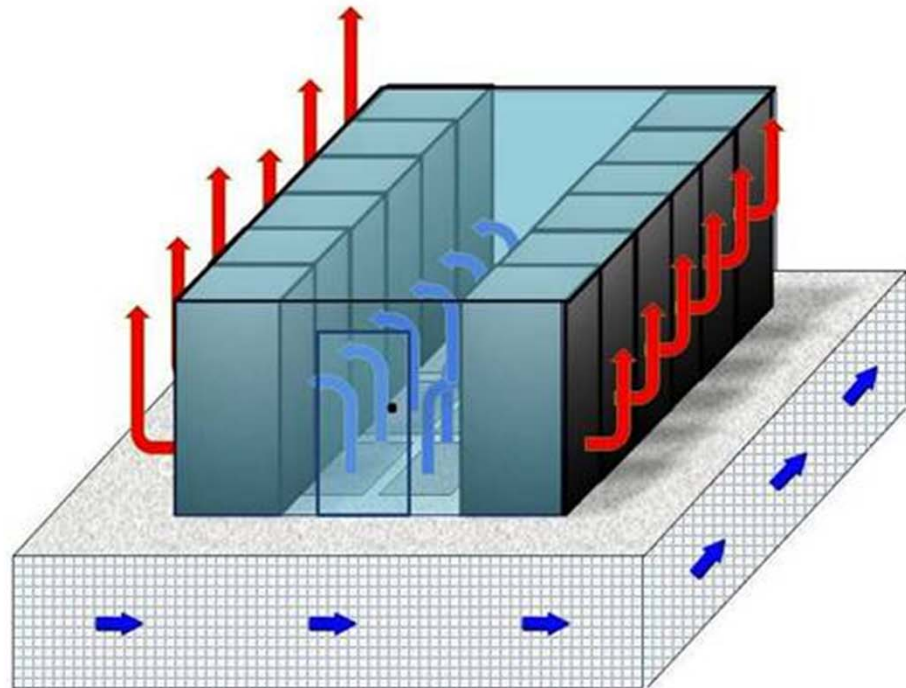
Benefits

- 100% Utilization

- Provides uniform cool air
  to equipment

- Isolates hot air from cool air

- High Return Temperatures

Planning For Data Centre's: Cold Aisle Containment

Negatives

- Redundancy planning (Thermal Mass)

- Room temperature is uncomfortable
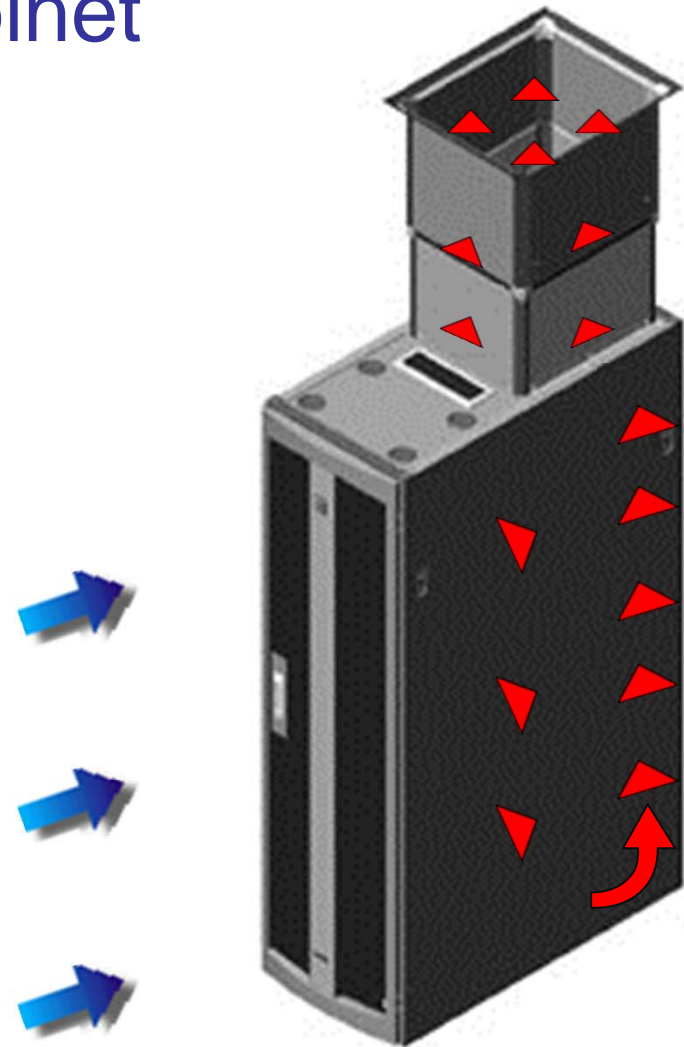
- Dependant on raised floor

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Planning For Data Centre's: Chimney Cabinet

Benefits

- Isolates hot air from cool air

- 100% Utilization

- High Return Temperatures

- Tier 4 solution

- Live deployments at 30 kW per cabinet

- Tested at 98kW!!!

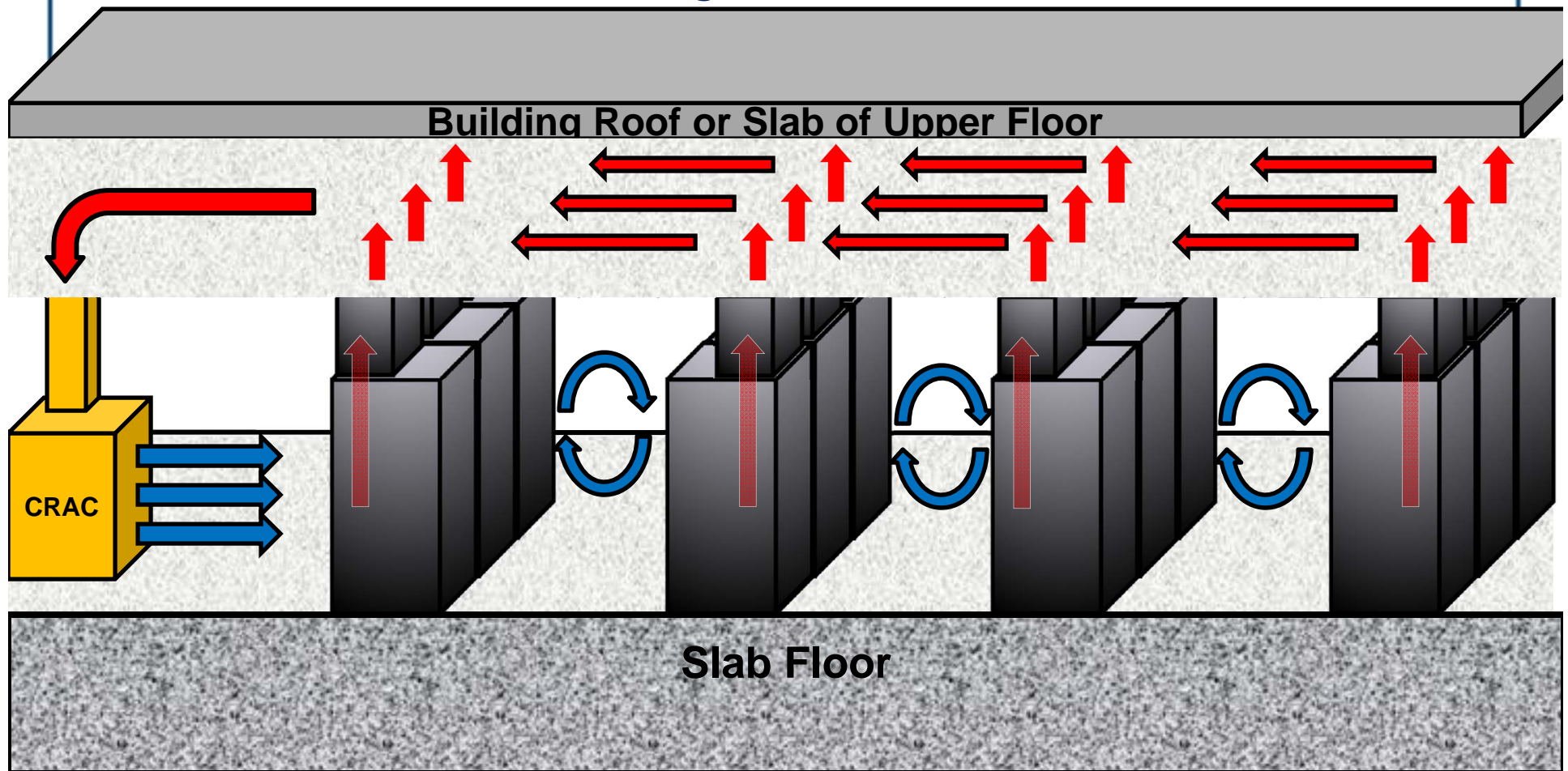# Planning For Data Centre's:
Chimney Cabinet

Negatives

- >1050 mm cabinet is required

- Return plenum is required for full isolation
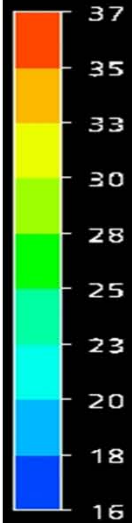
Air Cooled Cabinets

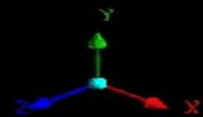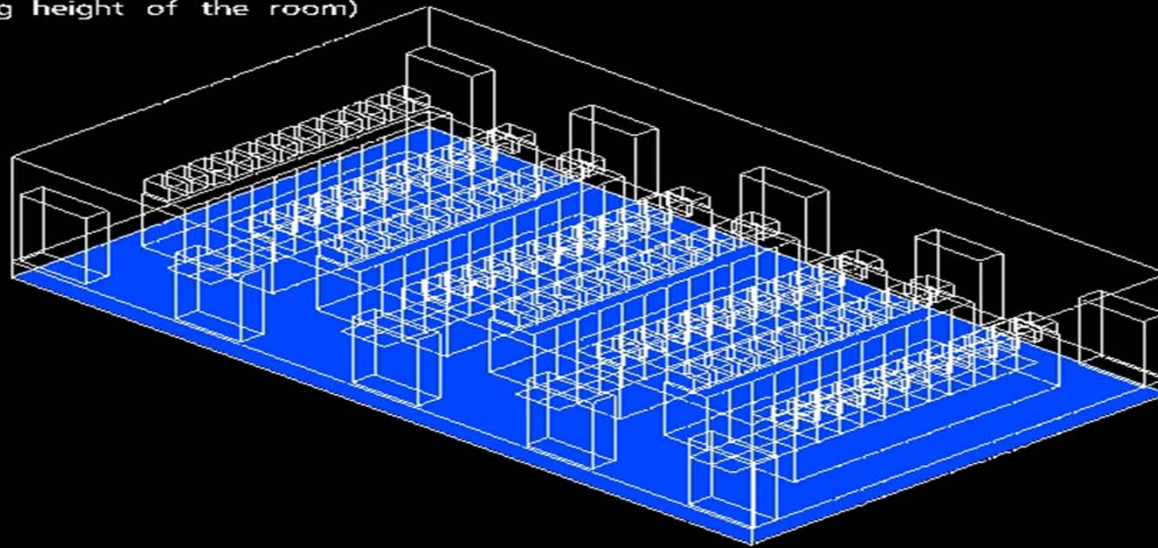## Put it All Together on a Slab Floor

Planning for Data Centre's

Removes hot air from the room,
temperature variation std deviation = 0

Summary

- **Heat loads in the data centre are rising**

- **Existing data centers can be improved now**

- **Strategies for heat capacity & efficiency are essential for new build data centers**

- **Green strategies are good for the environment & the corporation**

Thank You!
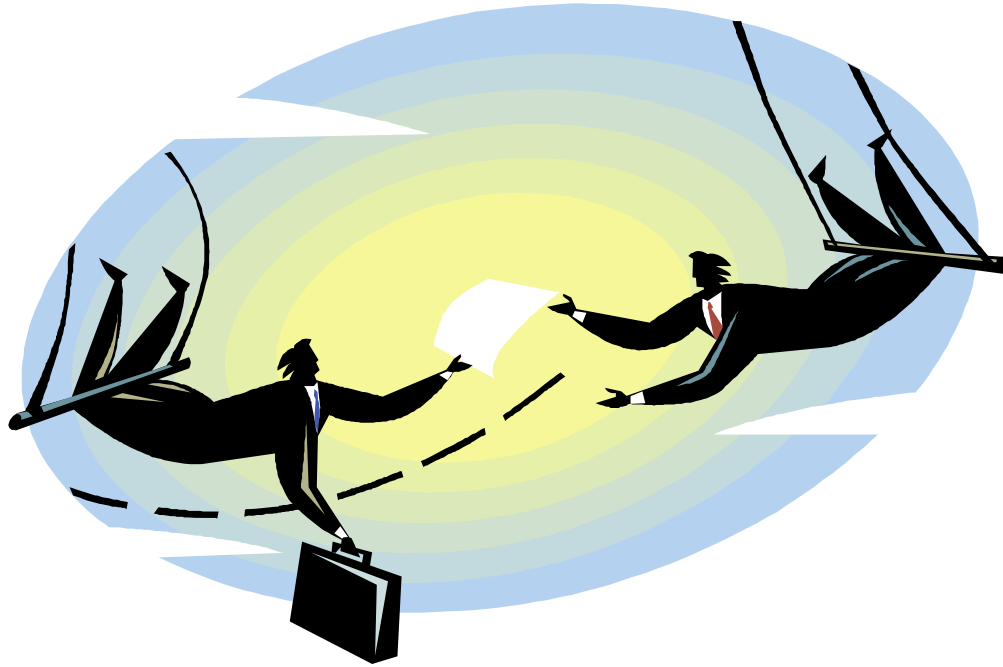
Questions?

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