# DirectAire® & DirectAire® X2

High Density Directional Airflow Solutions for Data Centers

Unlike other airflow panels the DirectAire and DirectAire X2 angle the airflow toward the server rack to significantly reduce bypass air. DirectAire is designed for a one-to-one pairing with a standard 42U rack while DirectAire X2 is intended to provide even airflow delivery to racks on either side of the cold aisle in a legacy data center that has only one accessible airflow panel. Both offer the same directional airflow, strong durable design and improved energy performance.

## Easily Cool High Density Racks

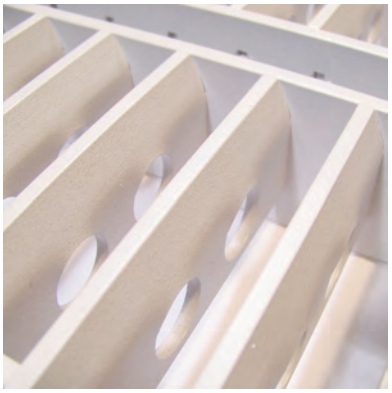
Both DirectAire's features **68% open area**, capable of delivering **2,600 CFM at .1" $H_2O$ static pressure.** More importantly each vane has a deflection angle at the top to direct the airflow towards the rack to achieve a **93% TAC** rate. This means 93% of the airflow delivered through the panel is entering the face of the server rack, providing the highest cooling capacity and energy efficiency. Compared to typical airflow panels which only deliver 30-50% directly to the rack. This improvement enables DirectAire to efficiently cool over **25kW per rack (X2 over 12.5kW per rack)**.

## Strong & Durable

Both DirectAire's feature all steel construction making them the strongest airflow panels on the market. With a **2000 lb Rolling Load, 2500lb Design Load and a Minimum Safety Factor of 2.0** equipment can be moved over the airflow panels without worry.

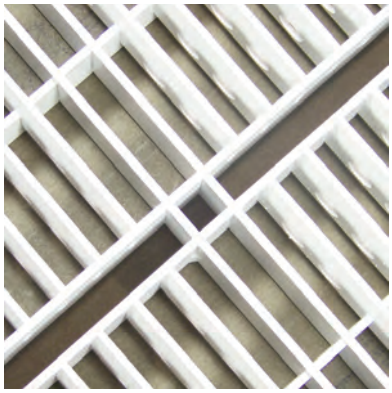
## Improve Data Center Financial Performance

DirectAire maximizes the financial performance of any new or existing data center. The precise delivery of air reduces bypass airflow allowing new facilities to reduce the number of CRAH units. Retrofits can set CRAH units with fixed speed fans to standby mode or adjust variable fan drives to operate at a lower static pressure, saving energy. Likewise the 93% TAC rate eliminates the need for a full containment system. The facilities overall cooling capacity will also be improved allowing for the addition of IT equipment without the capital investments on infrastructure.



**Directional airflow vanes provide 93% TAC**

**Designed for superior load performance**



**68% open area delivers 2600 CFM @ .1" $H_2O$**

## DirectAire Key Performance Characteristics

- Directional Air Flow Achieves a 93% Total Air Capture
- Pressure Equalizing Diffusion Blades
- Cools over 25kW per Rack
- Reduces Capital Expenditures on Cooling Infrastructure by 40%
- 68% Open Area delivers 2,600 CFM @ .1" H2O
- Over 40% Annual Fan Energy Savings
- 2,500 lbs Design Load boosted to 3,000 lbs with HD stringer

## DirectAire X2 Key Performance Characteristics

- Allows for directional airflow delivery to two racks when the existing cold aisle can only accommodate one airflow panel.
- Capable of cooling >12.5kW per rack due to evenly split nature of directional airflow paths



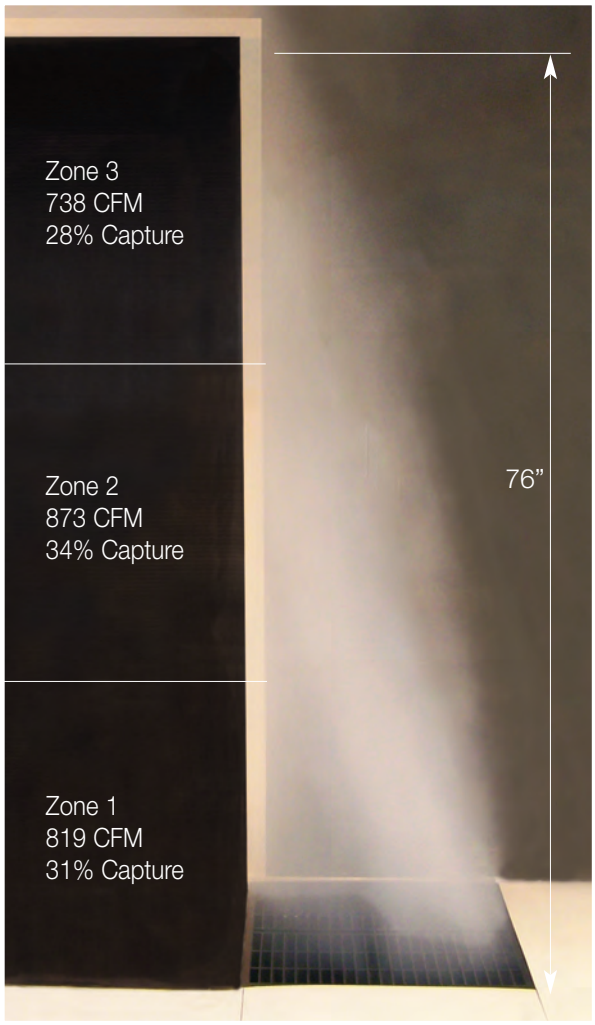
Tate®

# Total Air Capture (TAC) Rate

Total Air Capture (TAC) rate refers to the amount of air delivered through the airflow panel that is then captured by the server rack. The server rack profile below represents a standard 24" x 76" server rack. Lines have been added to show the three zones of the server rack. Zone 1 represents the bottom of the rack closest to the floor and Zone 3 represents the top of the rack farthest from the air supply. You will notice that the DirectAire panel delivers 93% of it's 2,600 CFM at .1" $H_2O$ to the face of the server.

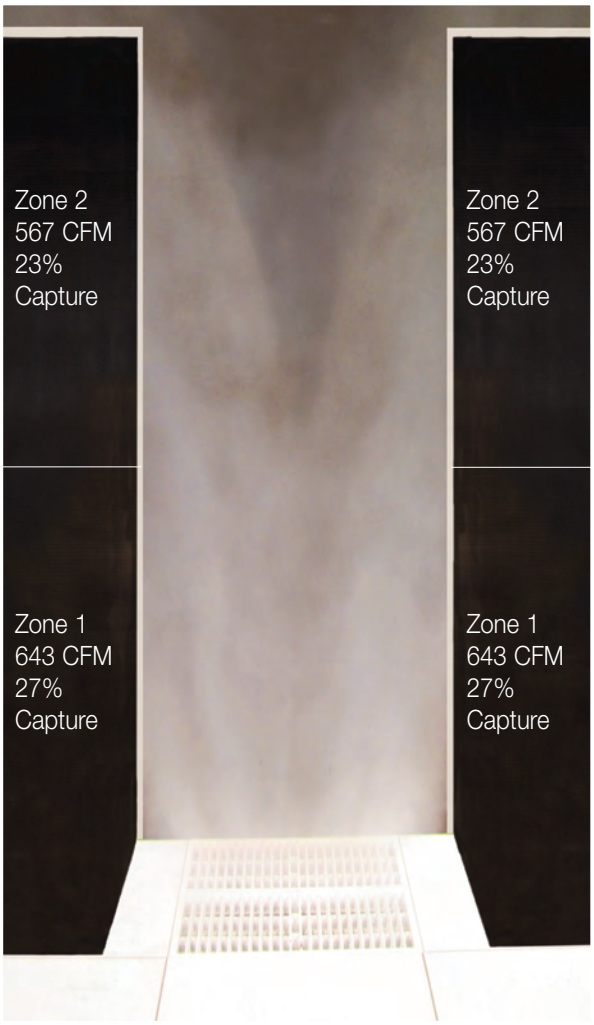
The data reported on the smoke test images below show the distribution of airflow through both panels for each zone in a 42U rack. You will notice the airflow through the DirectAire panel is spread evenly across the three zones of the rack. When racks are placed 6¨ from the edge of a DirectAire X2 panel as shown the airflow is divided evenly between the two adjacent racks.

**DirectAire**
**2600 CFM Delivered @ .1" H2O**
**2420 CFM Captured**
**93% TAC**




**The DirectAire smoke test above shows directional airflow path and air capture rate per zone at the face of a standard 42U server rack.**

**DirectAire X2**
**2600 CFM Delivered @ .1" H2O**
**2420 CFM Captured**
**93% TAC**



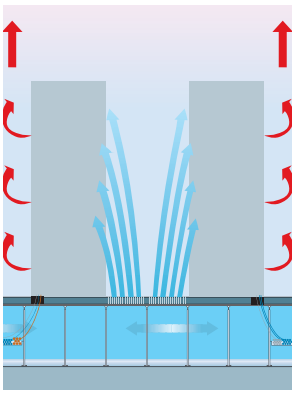

**The DirectAire X2 smoke test above shows directional airflow path and air capture rate per zone at the face of a standard 42U server rack.**

# Delivering Air in the Right Place

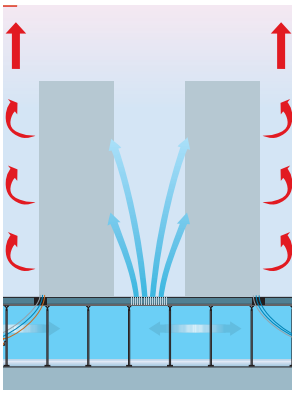
## DirectAire Reduces Bypass Air to Improve Capacity and Energy Efficiency

### Eliminate the Burden of Airflow Containment

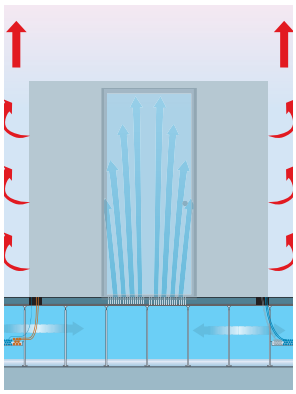
Containment systems in a data center come with many challenges including fire code requirements, service distribution restraints and limited flexibility. Unlike other panels which throw air straight up in a vertical plume the DirectAire's angular throw evenly distributes the majority of the air it delivers directly to the face of the rack providing effective containment when used in conjunction with best practices.



**DirectAire's 93%TAC rate enables you to gain near peak airflow without containment.**



**DirectAire X2 enables you to maximize airflow in aisles with a single row of airflow panels without containment.**



**Typical airflow panels require containment systems to ensure maximum airflow to the racks.**

### High Density Cooling Capacity

DirectAire's ability to deliver high volumes of air directly and evenly across the face of the server rack gives it the unique ability to handle very high density equipment. The table below lists cooling capacities per rack based on a mathematical calculation for systems without containment.

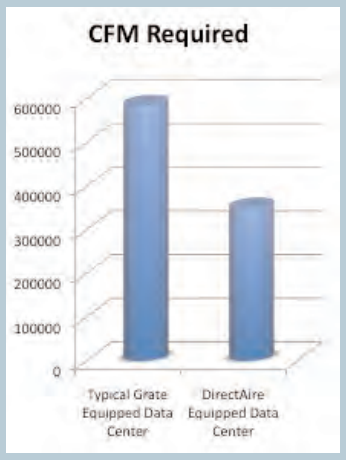
| **DirectAire & DirectAire X2 CFM & Cooling Capacity** | | | |
|---|---|---|---|
| Pressure (in. H2O) | CFM | **DirectAire** kW/rack w/o Containment* | **DirectAire X2** kW/rack w/o Containment* |
| .02 | 1151 | 8.5 | 4.2 |
| .04 | 1626 | 12.0 | 6.0 |
| .05 | 1844 | 13.6 | 6.8 |
| .06 | 2007 | 14.8 | 7.4 |
| .08 | 2318 | 17.1 | 8.6 |
| **.10** | **2594** | **19.1** | **9.6** |
| .12 | 2823 | 20.8 | 10.4 |
| .14 | 3027 | 22.3 | 11.2 |
| .16 | 3217 | 23.7 | 11.9 |
| .18 | 3378 | 24.9 | 12.5 |
| **.20** | **3433** | **25.3** | **12.7** |

*Cooling capacities were calculated using the following formula:

(CFM x Total Air Capture %) / 126*(CFM needed to cool 1kW @ 25ºF △)* = kW per rack.

### TAC Reduces Energy Usage

The total airflow required for cooling the same size data center is significantly reduced through the increased TAC rate provided by DirectAire. This reduction in total airflow has a dramatic effect on the fan energy required to move air throughout the data center.




**The chart shows over a 40% reduction in the Total CFM required to cool a typical data center with a 2MW IT load using a typical grate compared to DirectAire.**

***For more info on DirectAire's airflow and heat load capacity and learn how these tests were conducted download the white paper at: www.tateinc.com/infloor***

# Improve Your Financial Performance

## DirectAire Offers Energy Efficiency, Capital Investment Reduction and Excellent Payback

The energy savings realized through the use of a DirectAire airflow panel is made up of two components. The minor component is gained from the panel's large open area which allows the same airflow at a lower static pressure. The second and larger component, is realized through the DirectAire's 93% Total Air Capture rate. A typical uncontained cold aisle configuration assumes more than 50% of the air delivered will bypass the IT equipment. The **DirectAire reduces this bypass air to less than 10%** resulting in tremendous energy savings.

The potential for enormous first cost savings are available to new construction projects due to DirectAire's 93% TAC rate. The virtual elimination of bypass air enables the facility to operate safely using less CFM and therefore allowing for a significant reduction in the number of CRAH units required.

To evaluate the potential impact on the efficiency of your facility download our in-floor cooling cost model tool at: **www.tateinc.com/resources/cost_model.aspx**

| Example Data Center Characteristics | |
|---|---|
| User IT Load (kW) | 1720 |
| Number of Racks | 200 |
| Calculated Rack Density Average (kW) | 8.6 |
| Maximum IT Load Per Rack (kW) | 12.5 |
| Per kWHr Cost | 0.08 |
| Expected IT Equipment Utilization | 70% |

| | Baseline | RetroFit | New |
|---|---|---|---|
| Perimeter CRAH Unit Design | Typical Grate w/Belt Drive Centrifugal Fans | DirectAire w/Belt Drive Centrifugal Fans | DirectAire w/Belt Drive Centrifugal Fans |
| Rack Density for Calculation (kw) | 12.5 | 12.5 | 12.5 |
| Expected TAC % | 50% | 93% | 93% |
| Total Required CFM to be delivered (CFM) | 628,940 | 338,140 | 338,140 |
| CRAH Units Required (50 Ton Units) | 34 | 18 | 18 |
| Total Fan Power Required (kw) | 402.5 | 216.4 | 216.4 |
| Estimated Annual Energy Consumption (kWh) | 3,526,090 | 1,895,747 | 1,895,747 |
| Fan Annual Energy Cost $ | $282,087 | $151,660 | $151,660 |
| Required CFM Per Rack (CFM) | 1,572 | 1,572 | 1,572 |
| Required CFM Per Panel (CFM) | 3,145 | 1,691 | 1,691 |
| | | | |
| Cost Per DirectAire | | ($300) | ($125) |
| Number of Units Required | | 200 | 200 |
| Total Cost of DirectAire | | ($60,000) | ($25,000) |
| CRAH Unit Reduction Savings | | $0 | $560,000 |
| Fan Upgrades (EC Tech) | | $0 | $0 |
| | | | |
| Upfront Cost or Savings Using DirectAire | | ($60,000) | $535,000 |
| Annual Energy Savings | | $130,427 | $130,427 |
| Payback in Months (simple) | | 5.5 | 0.0 |
| 3 Year Savings | | $331,282 | $936,282 |
| PUE Impact | 1.80 | 1.69 | 1.69 |

**Retrofit Payback Less Than 6 Months**

# The Data Center is Rapidly Changing

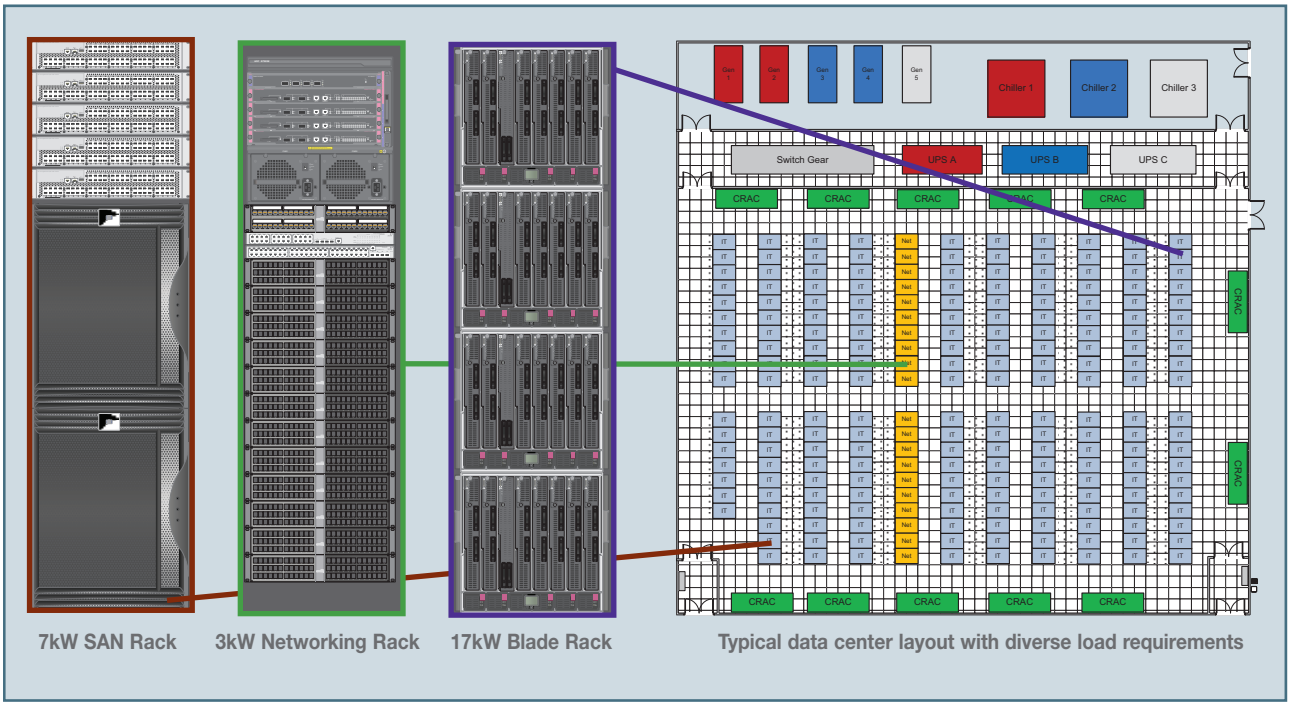
## Understanding and Managing Diverse & Variable Loads

### The Challenge of a Diverse Load Environment

The typical data center environment does not contain a single per rack density level, in fact it would be difficult to find any two racks in a large data center that consume exactly the same amount of energy. The load diversity results in differing airflow requirements per rack. Efficient cooling requires that the airflow delivered to each rack be matched to that rack's demand.

Each rack in the data center however is a constantly changing entity, with each add, move or change modifying the load. This of course changes the rack's airflow requirements, resulting in the need to manually adjust the airflow delivered from each panel to properly and efficiently cool the rack.

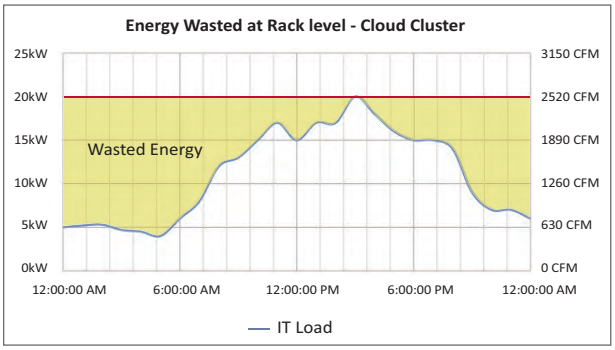
### Example of Load Diversity in a Typical Data Center




### The Variability Problem

This matter is further complicated when the load in the rack changes due to processing demands of the IT hardware at any given moment. This load variability has been driven by IT hardware that has become more efficient over time, increasing the difference between idle power consumption, and 100% utilization. This fact, coupled with the increasing use of cloud computing, will only serve to drive increased load variability in the rack on a minute by minute basis, making manual tuning of the airflow at the panel level impossible.

The solution has been to provide sufficient air to accommodate the peak energy demands of the rack, resulting in wasted bypass air and over-cooling during all less than peak conditions.




**This chart shows the energy wasted when variability in the energy consumed for the IT load exists at the rack level. The wasted energy in yellow exists when designing for peak load**

# Opposed Blade Damper

## Balanced Airflow for Diverse Loads

The Opposed Blade Damper offers a dramatic airflow improvement over traditional manual slide dampers. When fully open, it restricts airflow through the panel by just 10 percent. The damper's drop-in design allows for easy installation by decoupling the damper from the panel. This means that standard, undampered directional airflow panels can be ordered as needed, with separate opposed blade dampers purchased so they can be added whenever and wherever necessary.

The Opposed Blade Damper is available in three option, single zone, dual zone for use with the DirectAire X2 and multi-zone for targeted airflow control to diverse racks.

### Granular Airflow Control

The Multi-zone Opposed Blade Damper, when installed beneath a DirectAire directional airflow grate, significantly reduces bypass air and enables airflow delivery to be balanced based on the specific load in a 14U section of the rack. The damper allows for the individual adjustment of airflow to three zones within the rack (top, middle and bottom) without removing the DirectAire panel, ensuring fast and accurate balancing to the fixed IT load.

### Reduce Bypass and Save Energy

The Multi-zone Opposed Blade Damper can also be used when blanking panels cannot, to shut off or dampen airflow to different sections of the rack where large portions are left empty.

Another advantage is an increase in potential available critical power. The reduction in airflow volume as a result of using DirectAire's directional airflow and closing off airflow to unused sections of racks reduces the energy usage for cooling at the CRAC unit level. This can enable increased efficiency of the data center proportional to the deployment of the technology.

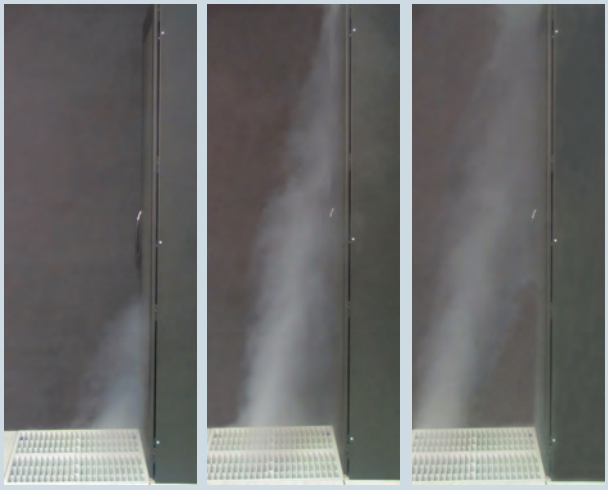
### Key Performance Characteristics

- Provides nearly double the airflow at 100% open than comparable slide dampers.
- Easily adjustable from above without panel removal when used with DirectAire.
- For use with full or partial loaded racks.
- Reduces cooling energy and improve PUE.
- Multi-zone dampers are for use with DirectAire only.
- Multi-zone dampers provide the most granular airflow control avaliable in Data Centers.

**Multi-zone Opposed Blade Damper**

**Adjust airflow without removing the DirectAire panel**

Smoke tests showing the Multi-zone Opposed Blade Damper operating in combination with the DirectAire Panel to target airflow delivery to the rack.

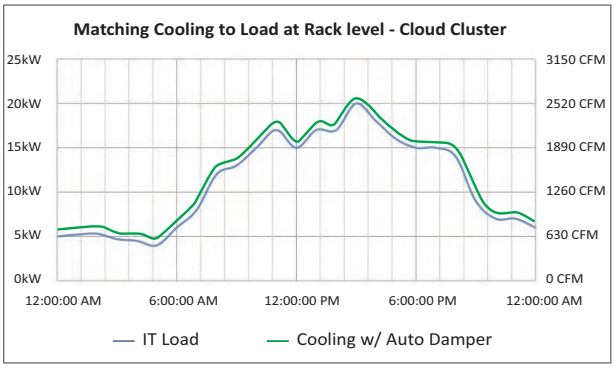


**Bottom 14U Zone** **Middle 14U Zone** **Top 14U Zone**

# Effectively Cool Variable Loads

Tate has adapted technologies readily found in commercial office applications to create a solution for controlling airflow delivery to the IT racks through the use of a variable-air-volume (VAV) device installed below each airflow panel. Each panel & rack tandem can be thought of as an individual zone.

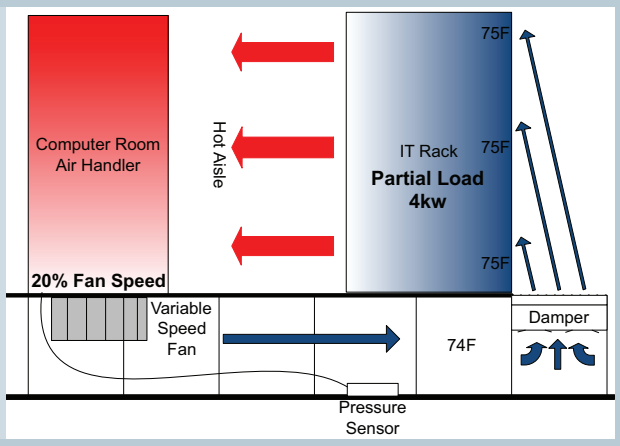
Using an automatic damper that measures the incoming air temperature at the face of the rack and adjusts the flow to ensure that the temperature at the face of the rack is never above the maximum allowable set point provided by the user. When deployed using best practices, the system is able to virtually eliminate bypass air, and account for any local temperature fluctuations.



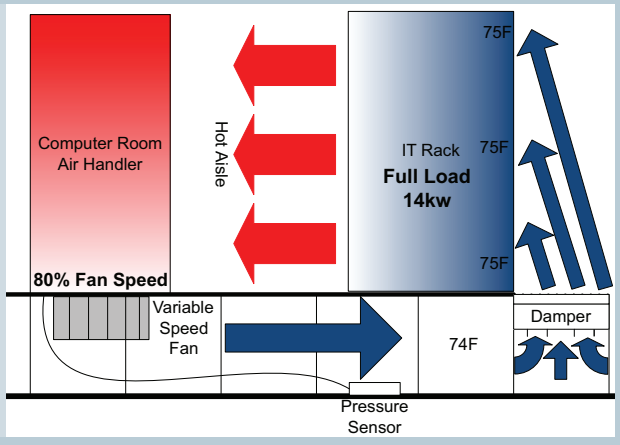

**By matching cooling to the IT load at the rack level the wasted energy that results from designing to peak load can be eliminated. By delivering only the right amount of air required to cool the rack a savings of over 40% in fan energy can be realized.**

## How it Works

**IT load is idle overnight at 4kW and 480 CFM per rack.**
Damper is nearly closed increasing the static pressure under the floor until the CRAH unit fans slow down to meet the desired static pressure, while at the same time meeting the inlet temperature requirements at the rack (75˚).




**IT load has increased to full load during the day at 14kW and 1680 CFM.**
Damper fully opens and the CRAH unit fans increase their speeds to hold a constant underfloor static pressure. Airflow to the racks is sufficient to keep all temperatures at the face of the rack at the desired 75˚

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