VERTIV

Vertiv™ Services eBook Series

Energy Efficiency Solutions for Your Data Center

Vertiv™ Services eBook Series

Energy Efficiency Solutions for Your Data Center

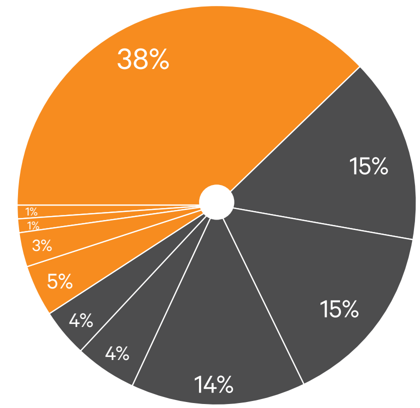
Chapter 1

VSD AND EC FANS

Executive Summary

Today's data center managers must respond to the constant state of change in the IT industry and look at strategies for optimizing a data center through management and planning. In this eBook we focus on energy efficiency via thermal management.

Energy efficiency has become a top concern because of the demand within nearly every organization for greater computing capacity, and the trend toward IT centralization has increased data center energy consumption significantly. With both energy consumption and costs on the rise, data center efficiency has been elevated to a strategy for reducing costs. Based on a 600 kW load, each percentage point in efficiency improvement translates into $6,000 in annual savings in operating expenses. Additionally, efficiency is viewed as a strategy to manage capacity – possibly saving capital costs – and promote environmental responsibility.



48% Power and Cooling	52% Computing Equipment
38% Cooling	15% Processor
5% UPS	15% Other Services
3% MV Transformer and Switchgear	14% Server Power Supply
1% Lighting	4% Storage
1% PDU	4% Communication Equipment

Category	Power Draw *
Processor	588 kW
Lighting	10kW
UPS and distribution losses	72kW
Cooling power draw for computing and UPS losses	429 kW
Building switchgear/MV transformer/other losses	28 kW
TOTAL	1,127 kW

Figure 1: *Analysis of a typical 5,000 square foot data center shows that demand-side computing equipment accounts for 52 percent of energy usage and supply-side systems account for 48 percent.*

**This represents the average power draw (kW). Daily energy consumption (kWh) can be captured by multiplying the power draw by 24.*

Chapter 1

VSD AND EC FANS

Executive Summary

From grid to chip, the data center offers a number of possibilities for lowering energy usage, with the thermal management system being an opportunity for significant improvement. In a typical data center, cooling accounts for 38 percent of total energy consumption. This means the thermal management system is where the biggest efficiency impact can be made.

Thermal management system fan improvements can save fan energy consumption by as much as 76 percent. This is important, because fans that move air and pressurize the data center's raised floor are a significant component of thermal management system energy use. In fact, on computer room air condition (CRAC) units, they are the biggest energy consumer.

The best approach to maximizing efficiency in a thermal management system is to match needs with load requirements. This is a challenge in the data center because thermal units are sized for peak demand which rarely occurs in most applications.

To reduce energy consumption, thermal units can be equipped with technologies that enable them to operate more efficiently when not at peak load. Variable speed drives (VSDs) and electrically commutated (EC) fans are two of these technologies. VSDs are also often referred to as variable frequency drives, or VFDs. We'll discuss why and how much these fans improve cooling efficiency and consider how to choose between the two options.

Chapter 1

VSD AND EC FANS

Variable Speed Drives (VSDs)

Fixed speed fans, both centrifugal and backward curved impeller (plug fan), have traditionally been used in thermal units. VSDs can be added to fixed speed fans, enabling the speed to be adjusted based on operating conditions — significantly improving energy efficiency. Adjusting fan speed to meet the changing load requirements is the most efficient method of control that allows for maximum savings at the fan while also impacting thermal efficiency, which will be addressed in detail in **chapter two** of this eBook.

Adding a VSD to the fan motor of a chilled-water thermal unit allows the fan's speed and power draw to be reduced as load decreases, resulting in a dramatic impact on fan energy consumption. A 20 percent reduction in fan speed provides almost 50 percent savings in fan power consumption. However, VSDs are limited to reducing fan speed up to 80 percent because they are not efficient when operating near or at peak load.

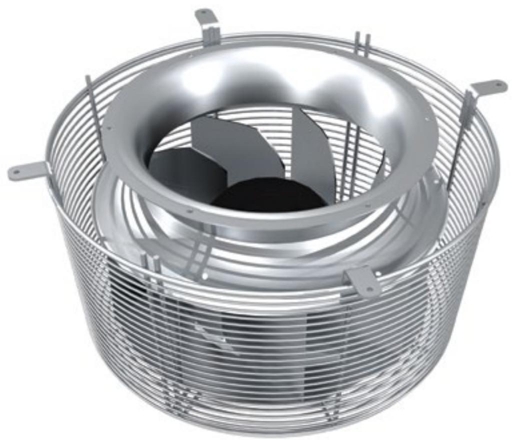
Chapter 1

VSD AND EC FANS

EC Fans

Like VSDs, EC fans are more efficient at partial loads because less fan power is needed. However, unlike VSDs, EC fans save energy even when the thermal unit is at full load. EC fans use a brushless EC motor in a backward curved motorized impeller (plug fan). The EC motor is actually a DC motor that can be connected to an AC supply line because there is a rectifier inside the motor drive. Speed control is achieved by varying the voltage direct current from zero to 10.

EC fans are inherently more efficient than traditional centrifugal fans because of their design and how they are integrated into the thermal unit. EC fans are direct drive and don't have belts. This means there are no belt losses, which constitute approximately five percent of the fan's total energy consumption.



Comparing VSD and EC Fan Efficiency

Independent testing of EC fan energy consumption compared to VSDs found that EC fans mounted inside the thermal unit created an 18 percent savings. With new units, fans can be located under the floor which could increase this savings.

The table below shows the results of independent analysis comparing the efficiency of centrifugal fans with VSD to EC fans mounted under the floor. The tests were conducted using a Liebert® CW™ chilled water precision thermal unit.

SPEED	MODEL FH 600C, 72F°/50% RH, 45E WT, 10° WATER TD 0.3" EXTERNAL STATIC PRESSURE	NET SENSIBLE COOLING CAPACITY (kBTUH)	MOTOR kW	EER (kBTUH/ kW)	CFM	SAVINGS FROM BASE
100%	Centrifugal blowers w/ VSD --- EC motorized impeller under floor	284.0	11.0	25.8	17,000	—
		296.0	7.6	38.9	17,000	-30.9%
90%		260.0	8.0	32.4	15,300	-27.1%
		268.0	5.5	48.4	15,300	-49.6%
80%		233.0	5.6	41.4	13,600	-48.8%
		239.0	3.9	61.4	13,600	-64.6%
70%		192.0	3.8	50.5	10,710	-65.5%
		194.0	2.6	74.6	10,710	-76.4%

**Energy analysis of fan system options based on Intertek's testing lab comparison using ASHRAE 127-2007*

Choosing Between VSD and EC Fans

Operational Considerations

BENEFITS	EC FANS	VSD
Most efficient for reduced operating costs	■	
Save energy even when the thermal unit is running fully loaded	■	
Suitable for ducted upflow thermal units which require higher static pressures		■
Distribute air more evenly under the floor resulting in more balanced cooling	■	
Easy component access for maintenance; requires less time to perform preventive maintenance activities		■
Have no fan belts that wear and have integrated motors that virtually eliminate fan dust thus requiring less maintenance	■	

Investment & Payback Considerations

BENEFITS	EC FANS	VSD
Lowest total cost of ownership over lifetime of unit; can cost 50% more but offers overall reduced maintenance costs and greater energy savings	■	
Offers faster payback on initial investment — fewer than 10 months when operatedat 75% (See Figure 2 on page 8)		■
Provides better long-term ROI (between 7-10 years) due to greater energy cost savings	■	

Choosing Between VSD and EC Fans

If the shortest payback is your priority, then VSDs are more likely the better solution. If saving the greater amount of energy is your primary objective, the EC fan is the better solution.

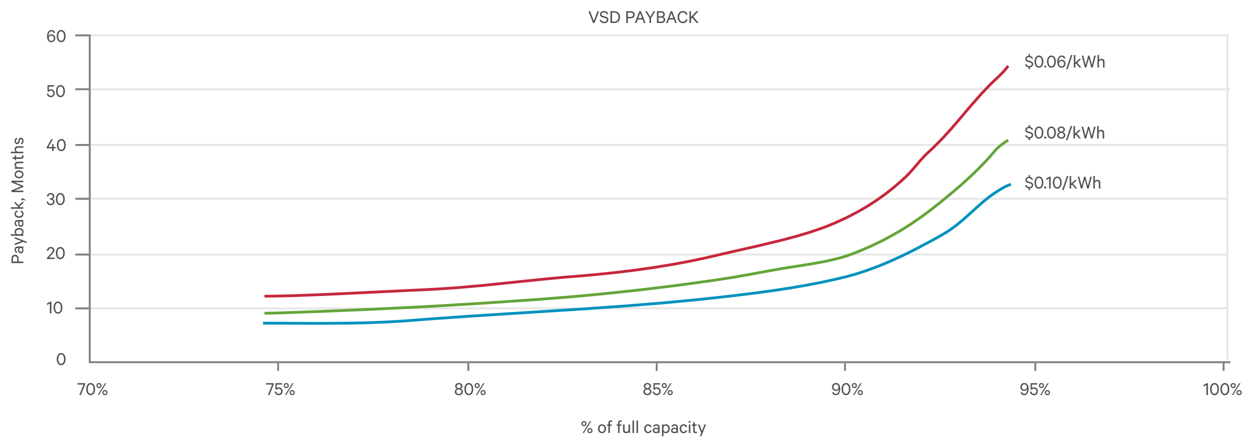


Figure 2

Installation and Maintenance

Both VSDs and EC fans can be installed on existing thermal units or specified in new units. When installing on existing units, insist on a factory-grade installation. The service professional should be able to adjust the fan speed to match changing requirements, thus providing the most efficient amount of cooling to the servers. All set points (thermostat, pressure, transducer, etc.) should also be checked to ensure everything works together to deliver maximum efficiency.

Maintaining maximum efficiency requires that VSDs and EC fans be a part of an overarching preventive maintenance program. It's important that these components are serviced according to the strictest standards as determined by the original equipment manufacturer.

Specifically, impellers need to be regularly inspected and cleaned of debris; belt tensions need to be checked and adjusted; and the operation of the fan safety switch needs to be verified. Additionally, you'll want to work with a service professional who understands how all the other components of the thermal management infrastructure can affect VSD or EC fan performance.

Working with service professionals to install these cooling fan technologies — and modify them based on conditions in the data center — creates the foundation for a data center in which efficiency can be optimized in ways that simply weren't possible five years ago.

Chapter 1

VSD AND EC FANS

Conclusion

Cooling efficiency can be improved significantly with the seamless integration of VSDs or EC fans which adjust speeds based on changing needs. Although EC fans are more efficient and provide a better long-term ROI, VSDs offer a faster ROI.

Ultimately, the best approach to achieving maximum thermal unit efficiency is having the original equipment manufacturer (OEM) service team, which has direct access to the engineering group who built the equipment and is specifically trained to optimize the performance of thermal management systems, provide a factory-grade installation. Ideally, the OEM will also adjust set points to meet room requirements, as well as maintain the equipment over time as part of a holistic approach to improving energy efficiency.

Both EC fans and VSDs can be used with a thermal system controller.
In **chapter two** of this eBook, we'll discuss how to multiply fan efficiency by pairing them with Liebert® iCOM™ controls.

Vertiv™ Services eBook Series

Energy Efficiency Solutions for Your Data Center

Chapter 2

INTELLIGENT CONTROLS + FAN TECHNOLOGY

Chapter 2

INTELLIGENT CONTROLS + FAN TECHNOLOGY

Executive Summary

In **chapter one** we noted that cooling accounts for 38 percent of data center energy consumption, concluding that improvements to the thermal management system will make the biggest impact on efficiency. We explored one method to achieve this, varying the thermal unit fan speed by employing electrically commutated (EC) fans or variable speed drives (VSD).

In this chapter, we look at a second element: using intelligent controls to bring high-level supervision to multiple thermal units. Additionally, we'll show how coupling intelligent controls with fan technology results in greater energy efficiency than using either intelligent controls or variable speed fans alone.

In fact, pairing the two will provide the biggest reduction in thermal management system energy consumption for most data centers.

Increase Energy Efficiency with Smarter Cooling

Integrating intelligent control capabilities into data center cooling brings high-level supervision to multiple thermal units, allowing up to 32 units to work together as a single system to optimize room environments and drive data center infrastructure performance. A unified thermal management environment can improve efficiency by 28 to 40 percent, depending on data center specifications and existing equipment.

Intelligent controls let you shift from thermal control based on return air temperature to control based on conditions at the servers, which is essential to optimizing efficiency. The controls ensure the optimum combination of compressor/chiller capacity and airflow, and they also often allow temperatures in the cold aisle to be raised closer to the safe operating threshold recommended by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (max 80.5° F; 27° C) for class A1-A4 data centers. According to Vertiv™ study, a 10° F (5.6° C) increase in cold-aisle temperature can generate a 20 percent reduction in thermal management energy usage.

Advanced intelligent controls such as the Liebert® iCOM™, featured on Liebert thermal management products including the Liebert DSE™, Liebert DS™, Liebert CRV™ and Liebert CW™, provide unit control, communication and monitoring to help optimize cooling performance and efficiently remove heat.

A thermal control system ensures all cooling fans work together to provide optimum efficiency and shift workload to units operating at peak efficiency while preventing units in different locations from working at cross-purposes. Without this type of system, a unit in one area of the data center may add humidity to the room at the same time another unit is extracting humidity from the room (unit “fighting”). The control system provides visibility into conditions across the room and the intelligence to determine whether humidification, dehumidification or no action is required to maintain conditions at target levels and match airflow to the load. Liebert iCOM controls without Optimized Aisle Control, discussed in the next section, offer two teamwork modes.

Chapter 2

INTELLIGENT CONTROLS + FAN TECHNOLOGY

Increase Energy Efficiency with Smarter Cooling

Teamwork Mode 1

Teamwork Mode 1 (Figure 1) is designed for small rooms with balanced heat loads. All network temperature and humidity sensor readings are averaged by the master unit. The master unit determines which operation the system is to perform (cooling, heating, humidifying or dehumidifying) and determines how much of the operation each individual unit is to perform (none, partial or full capacity).

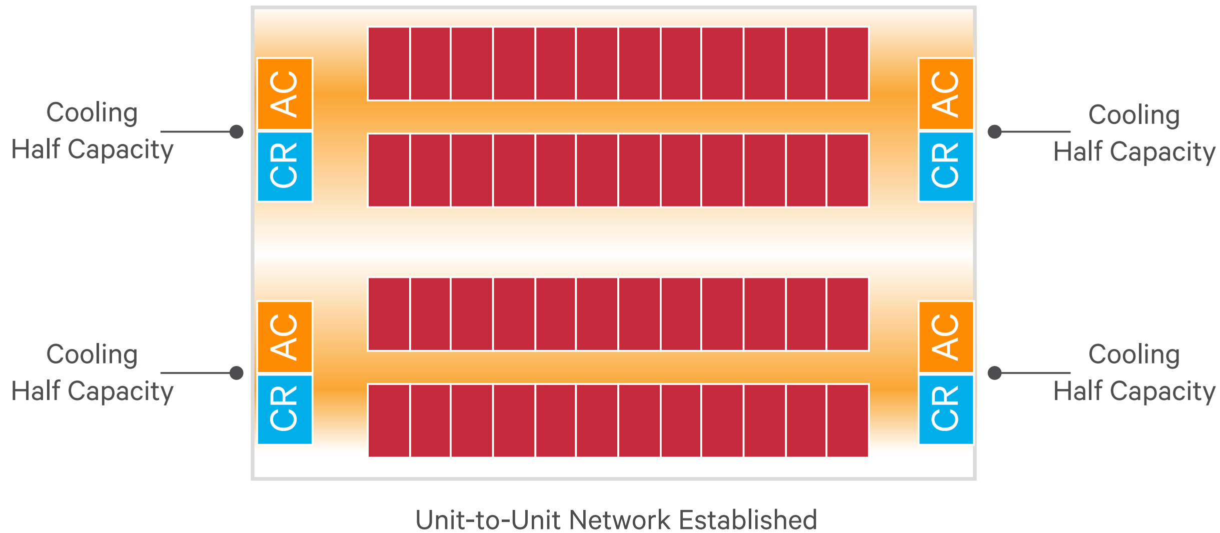


Figure 1: *In Teamwork Mode 1, the master unit has set all thermal units to "cooling" and "half capacity."*

Increase Energy Efficiency with Smarter Cooling

Teamwork Mode 2

Teamwork Mode 2 (Figure 2) is designed for large rooms with unbalanced heat loads. All network temperature and humidity sensor readings are averaged by the master unit, which determines which operation the system is to perform. However, unlike Teamwork Mode 1, each individual unit determines how much of the operation to perform based on its local sensor readings.

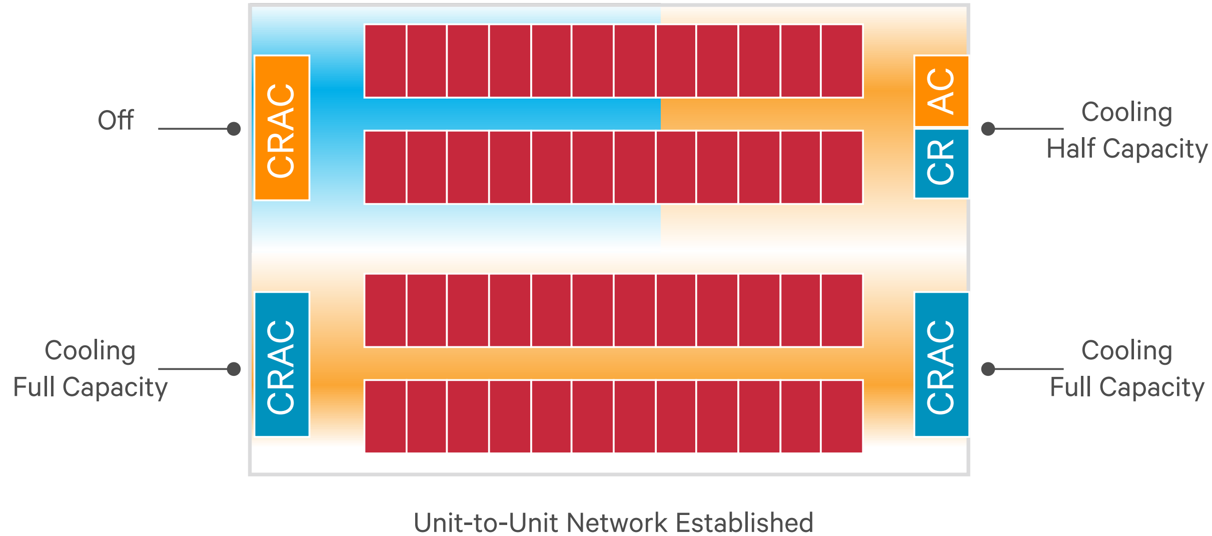


Figure 2: *In Teamwork Mode 2, the master unit has set all units to "cooling." However, based on varying heat loads to the units, two individual units have set themselves at "full capacity," one at "half capacity," and one has turned itself off.*

Increase Energy Efficiency with Smarter Cooling

Intelligent controls allow you to recover hours of energy that would be wasted due to unit "fighting" which amounts to significant annual savings. This energy efficiency case study reresents a customer with 32 thermal units operating as a single zone by utilizing the Liebert® iCOM™ control teamwork mode.

PERCENT OF OPERATING TIME WITH UNIT FIGHTING	RECOVERED HOURS	ANNUAL SAVINGS
5	438	$1,734
10	876	$3,468
30	2,628	$10,406

Figure 3: *The example assumes $0.10 per kW energy cost.*

Gaining More Efficiency by Coupling Intelligent Controls with Variable Speed Fans

The Liebert® iCOM™ control system featured on Liebert perimeter or row-based thermal management products is available with Optimized Aisle Control algorithms to provide enhanced airflow management and cost savings to data centers with row-based infrastructures. Liebert iCOM with Optimized Aisle Control "decouples" the compressor and fan operation. These components operate independently to match the IT load and the airflow requirements but are coordinated to maximize the efficiency of each component. Matching operation to room requirements results in warmer air returning to the thermal units, allowing the fan and the mechanical cooling to operate more efficiently, which eliminates overcooling and saves energy.

Each unit within the Liebert iCOM system operates both independently and as a team, providing optimal control and redundancy. If communication is ever lost, the units will operate independently to cool the head load as efficiently as possible.

Each controller supports multiple rack temperature sensors, as well as sensors for supply air temperature, return temperature and humidity in order to optimize operation based on user-defined temperature and humidity targets. Liebert iCOM leverages the variable capacity fans and compressors in Liebert thermal management systems, which allows the units to dynamically adjust capacity based on changing conditions and control airflow based on conditions at the rack.

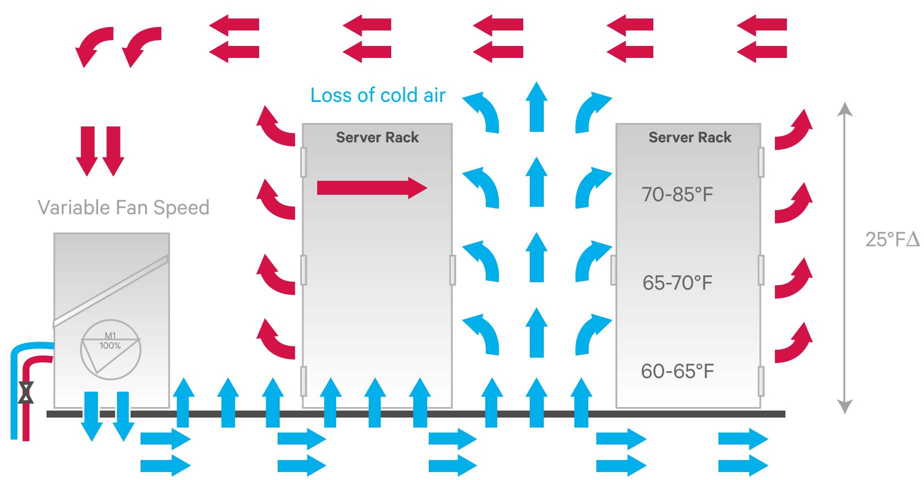


Figure 4: *The fan speed is too high in this data center, resulting in wasted energy from the loss of cold air.*

Chapter 2

INTELLIGENT CONTROLS + FAN TECHNOLOGY

Gaining More Efficiency by Coupling Intelligent Controls with Variable Speed Fans

The right airflow is important to the performance of the data center. Figure 4 shows what happens when there is too much cool air flowing through the rows. Notice the blue arrows that designate cold air. They extend above the racks, which means that there is a loss of cold air mixing with the return air which lowers the overall efficiency of the thermal unit.

Figure 5 shows how not enough cool air can create hot spots in the data center. This time the blue arrows barely reach the servers in the middle of the rack, which means virtually no cool air is reaching the top racks. The tops of the racks are at risk of overheating.

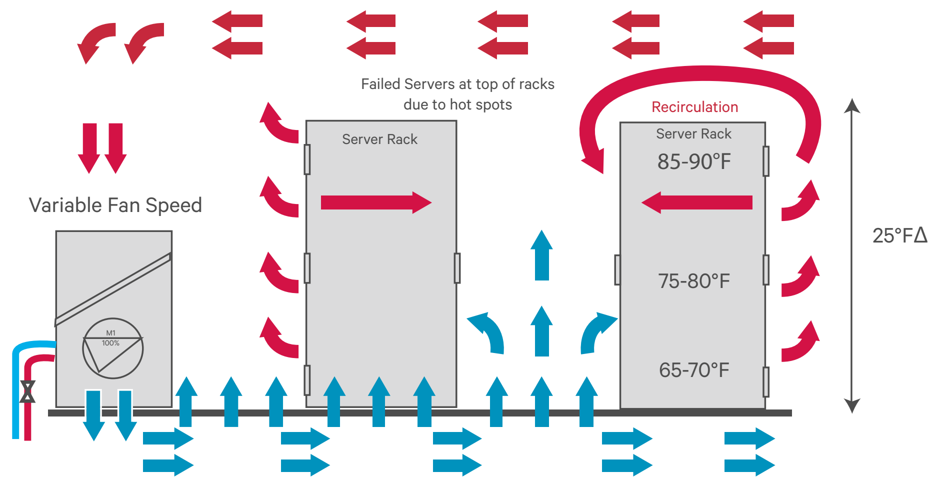


Figure 5: *Hot spots result when there is not enough airflow.*

Gaining More Efficiency by Coupling Intelligent Controls with Variable Speed Fans

Figure 6 shows the even distribution of airflow that can be achieved by utilizing intelligent controls with Optimized Aisle Control. Discharge temperature control maintains the cooling capacity of the thermal unit. Remote sensors in both the hot and cold aisles allow the intelligent controls to modulate compressor operation and thermal management system fan speed to ensure proper temperature, humidity and airflow to the inlet of the servers. A dedicated temperature control loop repositions the cooling capacity based on the temperature set point entered. A dedicated fan speed control loop repositions the fan based on the fan speed set point entered.

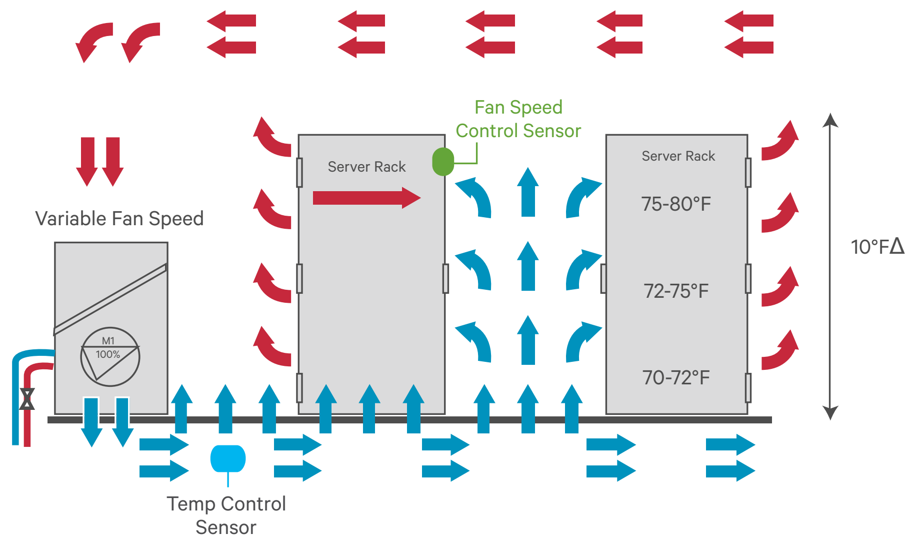


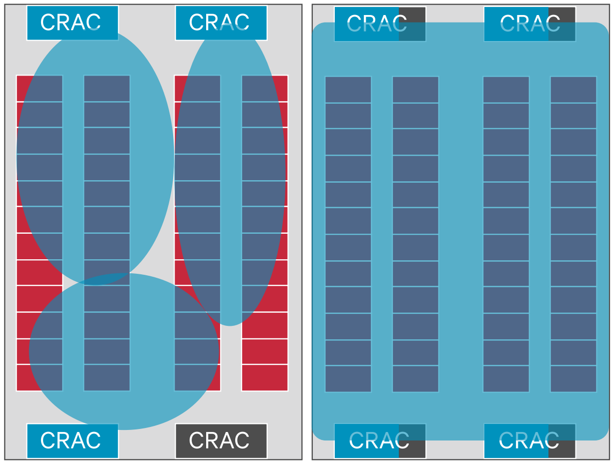
Figure 6: *Liebert® iCOM™ fan speed control sensors on the server racks match airflow to the conditions at the servers.*

Gaining More Efficiency by Coupling Intelligent Controls with Variable Speed Fans

Teamwork Mode 3

When the units are set to operate with Optimized Aisle Control and have been connected in a unit-to-unit network, the more sophisticated control of Teamwork Mode 3 can be selected. This mode allows the cooling capacity (supply sensor) to operate as a local control by removing only the amount of load required to maintain the discharge air temperature at each unit. This adjustment allows the room load to be unbalanced while a consistent discharge air temperature is maintained. The fan speed is controlled by the remote rack sensors of all units, providing controlled air delivery to the cold aisle. In raised floor applications, units will share sensor information to achieve even under-floor air distribution. This distribution is achieved by operating all fans in parallel, which also provides the greatest energy efficiency.

Figure 7 shows the difference in both under-floor air distribution and energy consumption when variable fan speed and Teamwork Mode 3 are applied to Liebert® thermal units. The example on the left is using the standard standby configuration and the example on the right is utilizing Teamwork Mode 3.



Standard Standby Configuration

Teamwork Mode 3

STANDARD (FIXED SPEED)	TEAMWORK MODE 3 (VARIABLE SPEED)
3 units on, 1 in standby	4 units operating together
Fans must operate at 100% to meet demand	Fans can operate at 75% to meet demand
3 units x 8.1 kWh = **24.3 kW per hour**	4 units x 3.43 kWh = **13.72 kW per hour**

Figure 7: *Typically, operating four fans at partial load (3.43 kWh) takes less energy than to run three fans at full load (8.1 kWh). In this scenario, variable speed saves a total of 10.58 kW per hour.*

Gaining More Efficiency by Coupling Intelligent Controls with Variable Speed Fans

Besides enabling teamwork, unit-to-unit communication allows cooling capacity coordination, zoned airflow distribution, fail-over protection and different modes of standby operation, as described below.

Cascade: When data center environments require the thermal management equipment to modulate from very low loads to the full-design load, Liebert® iCOM™ can coordinate unit capacity and unit activation in accordance with the Teamwork Mode 3 operation previously described. The Liebert iCOM controlled units that are placed into standby mode will activate as the room environment demands more cooling capacity. Liebert iCOM will monitor the rack sensors and current operating state of each unit to determine when to activate a standby unit.

To provide the most efficient operation from a system perspective, the Liebert iCOM will first adjust the fans and chilled water valve of the operating units to compensate for the increased heat load. Once the operating units have reached a set fan speed, the supply compensation will be activated to determine if a lower supply temperature can compensate for the load increase. Once the supply compensation routine has reached its threshold, the Liebert iCOM will activate a standby unit within the group.

Lead/Lag–Failure Scenarios: When redundancy configurations are required, the Liebert iCOM unit-to-unit network has built in fail-over conditions so you won't have to interact with the system should a failure occur. The first and probably most common failure scenario is a single unit or component failure. In this situation, the Liebert iCOM will automatically activate a standby unit in the place of the failed unit.

Gaining More Efficiency by Coupling Intelligent Controls with Variable Speed Fans

Unit-to-unit and sensor failure scenarios have also been programmed into the Liebert® iCOM™ controller. For example, if the remote sensors fail at the unit level, the unit will continue to operate using the other unit's remote sensor values. If all remote sensors fail, the fan speed will begin to operate from the supply sensor. If the supply air sensor fails then the unit will default to 100 percent fan and cooling capacity. In the event of a unit-to-unit failure, each unit will operate from its individual sensor network.

Additional energy-saving features offered by the Liebert iCOM controller include back-draft fan damper and advanced DX freeze protection. The controller can operate EC fans at very low revolutions per minute (RPM) to effectively act as a back-draft damper. The power used to prevent airflow from entering a standby unit from the raised floor by spinning the fans at a low RPM is much less expensive than the additional static that conventional mechanical dampers introduce while the unit is in operation. Advanced DX freeze protection provides the ability to predict freeze conditions and correct this condition automatically by adjusting the fan speed and compressor capacity.

Chapter 2

INTELLIGENT CONTROLS + FAN TECHNOLOGY

Moving to Performance-Based Maintenance

Beyond the significant energy efficiency benefits intelligent controls afford, facility managers can look forward to performance-based maintenance. Because the controls provide more information for every data center infrastructure component, you can break out of break-fix mode. You'll have predictive information based on component performance, to help you eliminate downtime.

To ensure most data centers can benefit from the energy efficiency of intelligent controls now and in the future, Liebert® iCOM™ is compatible with building management systems (BMS) or data center infrastructure management (DCIM) systems via many open and/or proprietary communication protocols. It also enables remote service delivery and future technologies such as wireless, and can interface with the latest condenser to optimize the efficiency of air-cooled units. If you have Liebert cooling that is not equipped with the Liebert iCOM control or a variable speed fan, it is likely there is an upgrade for your unit.

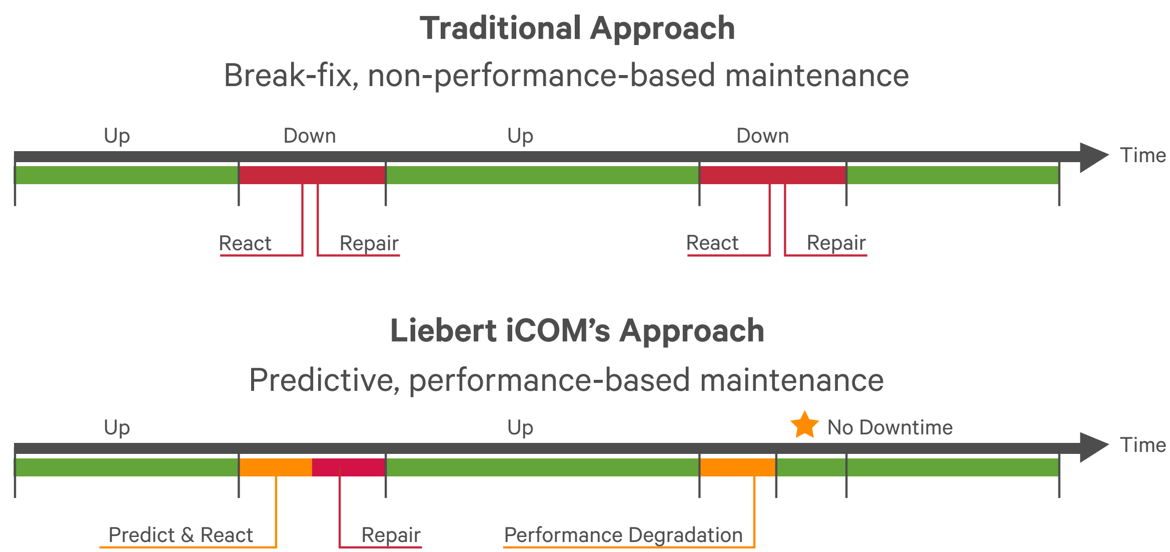


Figure 8: Information from intelligent controls enables performance-based maintenance and helps data center managers be better prepared for the unit repairs needed to keep their infrastructure up and running.

Conclusion

Each change made to a data center cooling infrastructure provides incremental energy and cost savings. However, a robust and holistic approach is ideal.

For example, variable speed fans (VSDs or EC fans) improve the energy consumption of just the fan. Having the fan technology alone doesn't measure the impact that changing fan speed has on the overall data center cooling or whether a compressor has increased power consumption to account for lower cooling. Therefore, integrating variable speed fans into the controller is key to ensuring optimal performance of the fan itself, as well as optimal cooling for individual units and the data center as a whole. This integration ensures ideal cooling with the least energy usage by the fans and compressors.

Adding in teamwork functionality compounds the savings. Through teamwork, the Liebert® iCOM™ control optimizes component performance while reducing energy consumption of all networked units. Teamwork Mode 3, in particular, allows the Liebert iCOM to further reduce energy consumption by providing just enough airflow and just enough cooling at the server inlets to create the best cooling environment with the least possible energy consumption of the fans and compressors.

Designing intelligence into the infrastructure is one of the most effective ways to improve energy efficiency in the data center. By significantly increasing the data gathered through performance-based monitoring, leveraging variable capacity technology and applying proprietary algorithms, Optimized Aisle Control is able to save energy while protecting IT equipment and data center operations.

Want to ratchet your energy efficiency up another notch?
Check out **chapter three** to learn about the benefits of thermal control optimization.

Vertiv™ Services eBook Series

Energy Efficiency Solutions for Your Data Center

Chapter 3

THERMAL CONTROL OPTIMIZATION

Chapter 3

COOLING CONTROL OPTIMIZATION

Executive Summary

Energy efficiency has become a top concern because of the demand within nearly every organization for greater computing capacity. In addition, the trend toward IT centralization has increased data center energy consumption significantly. With both energy consumption and costs on the rise, data center efficiency has been elevated to a strategy for reducing costs. However, the typical practice of making thermal unit improvements one at a time misses the opportunity to optimize the total thermal management system.

In previous chapters of this eBook, we've discussed a more holistic approach to improving energy efficiency via thermal management. We highlighted the use of **variable speed fans**, and the combination of that fan technology with **intelligent controls**. The use of intelligent controls brings high-level supervision to multiple thermal units and is an excellent approach to achieving energy efficiency goals.

In this chapter, we go beyond the importance of having intelligent controls to discussing the need for optimizing those controls to realize peak performance. Additionally, we highlight the importance of working with thermal management experts during this optimization process in order to benefit from a fully integrated cooling system that supports the entire data center infrastructure.

Chapter 3

COOLING CONTROL OPTIMIZATION

Why Conduct Thermal Control Optimization?

Thermal management systems have become increasingly complex over the years, moving from single-unit rooms to data centers with multiple systems that work together to provide cooling to the critical space. This increased complexity, along with the constant changes in the data center environment (including frequent changes in load requirements and external weather conditions), make it even more important to have a way to adjust in order to operate efficiently.

Thermal control optimization, when done properly, optimizes a thermal unit to the load and room conditions. Doing this helps configure data center thermal management systems for peak performance based on your specific application by eliminating unit fighting, improving load sharing and reducing energy consumption. Vertiv™ has found that our unified cooling system with intelligent control capability provides the added flexibility to help customers realize improved efficiency by 10 to 20 percent.

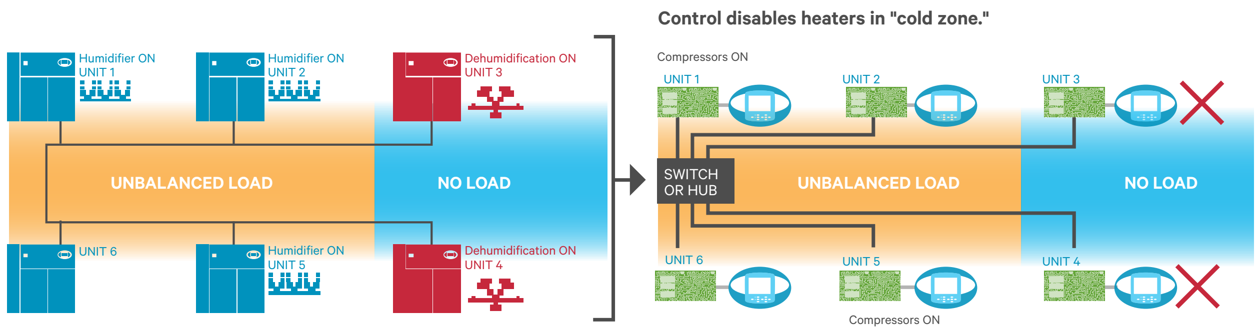


Figure 1: System-level control after optimization reduces conflict between room air conditioning units operating in different zones in the data center.

Chapter 3

COOLING CONTROL OPTIMIZATION

Getting Started

The first step in thermal control optimization is working with a specialist to review your existing infrastructure. This will typically include the gathering of your equipment's models and serial numbers. Next, an on-site consultation in which a technician walks with you through the data center, allows for a thorough assessment, and better understanding of the goals and priorities for the critical infrastructure.

The technician will then review various thermal controls and make recommendations based on what is found. For example, if the room is designed for a 200 kW load but only 25 percent of capacity is being used, infrastructure equipment can be configured to operate at 25 percent load so that capacity isn't wasted. The technician will also describe how recommended changes will affect equipment performance and solicit your feedback.

Chapter 3

COOLING CONTROL OPTIMIZATION

Getting Started

Specific thermal controls that may be optimized, depending on your thermal management system, include:

- Temperature and humidity set points – Proper set points help to reduce energy consumption, improve compressor life, and reduce "fighting" between units due to excessive humidification or dehumidification.
- Networking and teamwork mode – These advanced controls need to be set based on equipment type, options utilized, thermal load, location and other factors in order to eliminate excessive dehumidification, maximize free cooling and cut down on wear due to the start and stop of compressors.
- Optimized Aisle Control mode – If part of your data center, this optimization will include recommendations for sensor locations, and help with configuring remote sensors and teamwork mode.

Chapter 3

COOLING CONTROL OPTIMIZATION

Temperature and Humidity Set Points/Settings

IT systems are critically sensitive to extreme variations in temperature and humidity, so making proper set point/setting adjustments is very important to the operation of your thermal management system.

High heat or humidity can cause failure, degrade performance and shorten equipment life. Too low humidity can cause static electricity to build up and discharge (electrostatic discharge), which can shut down electronic equipment, possibly damaging it and/or causing data loss.

Additionally, excess cooling wastes energy. Often, temperatures in the cold aisle can be raised if current temperatures are below 68 degrees Fahrenheit.

The safe operating threshold recommended by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is maximum 80.5° F (27° C) for class A1-A4 data centers. ASHRAE also recommends 20 to 80 percent humidity. Keep in mind that your specific situation may require tighter controls in order to be more efficient.

Chapter 3

COOLING CONTROL OPTIMIZATION

Networking and Teamwork Mode

Rising equipment densities have increased diversity within the data center causing rack densities to rarely be uniform, thus leading to cooling inefficiencies. However, this issue is resolved by control coordination and optimization.

Thermal control systems can function based on conditions across the data center and enable cooling based on conditions at the servers, which is essential to optimizing efficiency. The controls ensure the optimum combination of compressor/chiller capacity and air flow, and often allow the temperature to be raised in the cold aisle.

This functionality also contributes to efficiency by allowing multiple thermal units to work together as a single system utilizing teamwork. The control system can ensure all cooling fans are running at the same speed for optimum efficiency; shift workload to units operating at peak efficiency; and prevent units in different locations from working at cross-purposes. Without this type of system, a unit in one area of the data center may add humidity to the room at the same time another unit is extracting humidity from the room.

When optimizing network and teamwork modes, a technician will check the network connections and configure the appropriate IP address for the mechanical network. He or she will also do the following:

- Determine the correct teamwork mode based on room design and your input
- Configure appropriate teamwork mode, lead/lag-standby, rotation and cascade
- Confirm proper operation
- Document the teamwork settings in the electronic report

Chapter 3

COOLING CONTROL OPTIMIZATION

Optimized Aisle Control Mode

If you have the Liebert® iCOM™ control system with Optimized Aisle Control, it will be configured to match your room requirements and deliver maximum efficiency based on your application. Liebert iCOM controls on Liebert thermal units communicate with each other through a private mechanical network to coordinate the following:

- Cooling capacity
- Zoned air-flow distribution
- Failover protection
- Different modes of standby operation

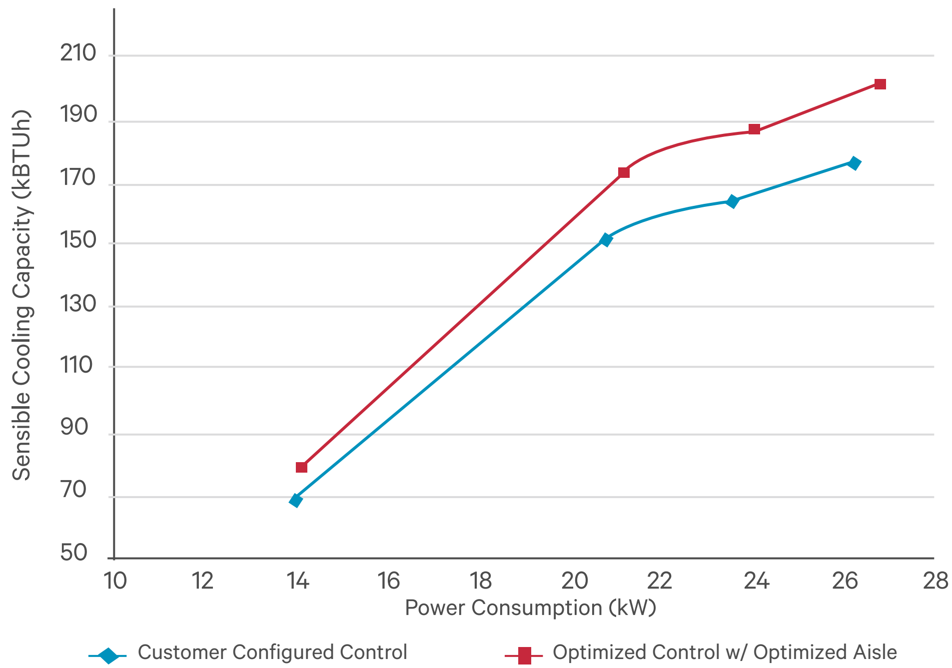


Figure 2: *Over time, utilizing the Liebert iCOM control system with an optimized aisle configuration and control setting improves efficiency. Having those controls optimized properly by a factory-trained technician provides more capacity with similar levels of power consumption than if those controls were configured by the customer alone.*

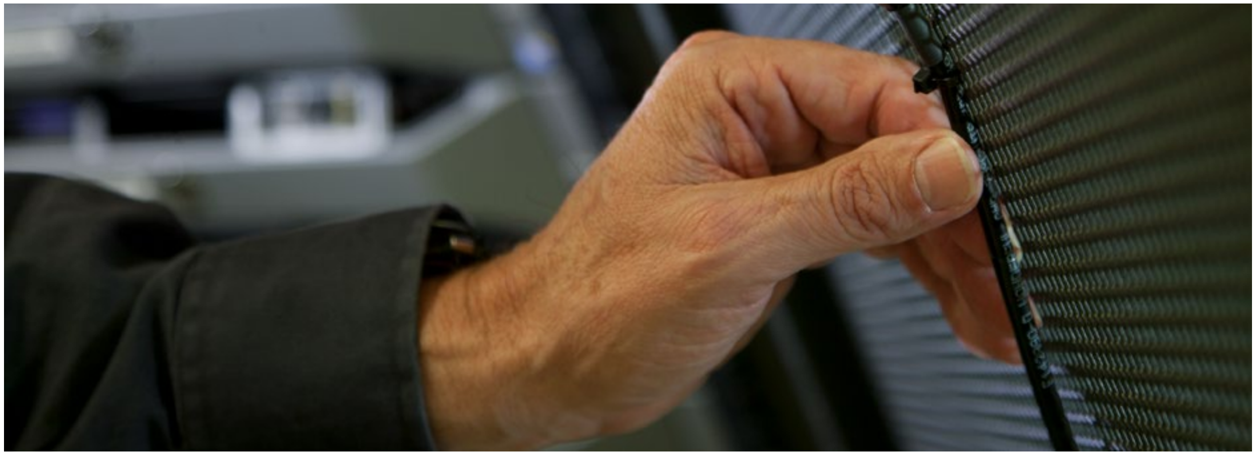
Chapter 3

COOLING CONTROL OPTIMIZATION

Optimized Aisle Control Mode

Units connected in a unit-to-unit network and set to operate in Optimized Aisle Control mode can utilize a teamwork mode to share sensory data and provide coordinated cooling and humidity control among thermal units. This provides efficiency improvement of 10 to 30 percent, depending on row or aisle configuration, aisle containment and proper set-up.

The sensors that tie units together are key to Optimized Aisle Control functioning. When this aisle configuration is part of your data center, optimization confirms the sensor array is properly installed and configured, and includes setting the sensors and control type. The units are then configured for Optimized Aisle Control. Lastly, proper operation is confirmed and all settings documented in the report.



Chapter 3

COOLING CONTROL OPTIMIZATION

Conclusion

Cooling technologies are evolving quickly to meet the needs of data center operators. Systems with more advanced and often more complex technologies are introduced to the market frequently. Setting up the features of these systems takes knowledge and time. Top-quality thermal control optimization should include the following:

- Consultation with a service provider to determine the goals and priorities of the critical infrastructure, and understand how changes will affect equipment performance.
- Configuration of settings to extend equipment life, improve availability and boost overall efficiency.
- Networking of controls and establishing the proper teamwork mode to allow coordination among multiple thermal units.
- Documentation of control settings and work completed during the optimization.

While optimizing thermal management system controls when new equipment is installed offers the most benefits, optimization can be completed at any point. It is important to remember that a technician who is data center focused and factory-trained by the original equipment manufacturer (OEM), knows the technology and works with it every day.

Many service providers understand how to install thermal management equipment, but the experts of the Vertiv™ Services team have the experience needed to ensure peak performance of these systems after they are installed and to integrate them into the data center infrastructure support strategy for maximum efficiency and reduced costs.

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