COMMSCOPE®

White Paper

Lighting and the efficient data center

How data centers are using lighting with intelligent sensors to reduce energy consumption and improve operations

redwood®

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This paper describes the role that lighting plays within data centers. While a common approach to lighting in data centers is to leave the lights off, there are practical reasons why many data centers cannot adopt that approach. Though lighting is not a major component of the energy load in a data center, it is an infrastructure area that is relatively easy to address. CommScope's Redwood intelligent lighting network solution represents one of the more efficient methods of lighting a data center.

Executive summary: lighting and the efficient data center

As data center operators and architects consider different ways to make their data centers more efficient, often the last area they consider is lighting. While lighting only comprises 3 to 5 percent of a data center's energy load, it's one of the easiest areas to address—one that will help take a data center with good Power Utilization Effectiveness (PUE) to one with great PUE.

Lighting has not gone unnoticed by industry experts. The Telecommunication Infrastructure Standard for Data Centers ANSI/TIA-942-A recommends that data center operators implement LED lighting within their facilities. However, just changing the lighting doesn't make the data center as efficient as it can be. In this paper, we will look at different approaches to data center lighting and define the approach that requires the least amount of light and results in the greatest overall efficiency.

What is the most efficient lighting approach for a data center?

The most efficient way to provide light in a data center is to use it precisely when and where it is needed. This is effectively a lights-out data center approach. While many data center operators believe they operate a lights-out type of facility, in actual practice, they do not. In facilities with this type of policy, lights are turned on manually across a large swath of space when a technician enters the racks to get to a particular small section of the site, such as an aisle. Lights often remain on long after the technician has departed because they were never turned off, sometimes simply because the technician doesn't know whether anyone else is present or not. This scenario creates a perfect opportunity to introduce innovative lighting control techniques.

For example, a recent webinar conducted by ComputerWorld[1] featuring KC Mares from MegaWatt Consulting described new techniques used by data centers with exceptional PUE. Notably, KC discussed an approach called follow-me lighting used at Facebook's Oregon and North Carolina data centers. Follow-me lighting acts as a spotlight, putting lighting only where the technicians need it. As people move through their facility, only the lights above the technician are illuminated. In order to do this, they have motion-detecting sensors at each light fixture. These sensors tie into a central application that determines which lights come on and the light's intensity.

The follow-me approach solves the problem of putting light only where it's needed, but the type of fixtures used also has a big impact. The inexpensive and familiar solution is fluorescent fixtures.

1 - Improve Data Center Efficiency through Building-Performance Lighting and an Intelligent Infrastructure - http://www.redwoodsystems.com/news-events/webinars

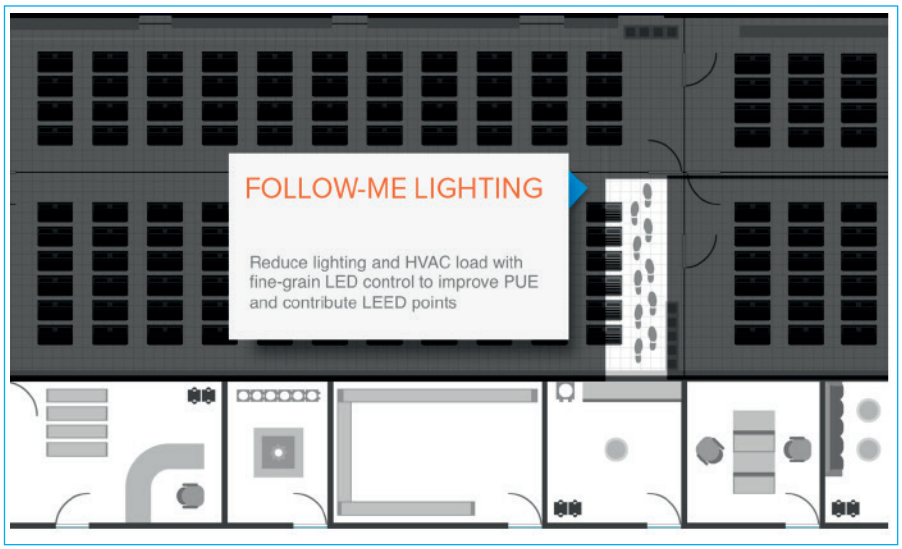

Figure 1: follow-me lighting in the data center

Fluorescent lights are an improvement over incandescent lighting. They have been around a long time, and they're relatively inexpensive. In the last 10 years, their efficiency has improved by producing smaller tubes with dimmable ballasts. However, they still have their drawbacks.

First, the life of a fluorescent lamp diminishes with the number of starts it endures[2]. In a follow-me lighting environment, the lamps will undergo at least twice as many starts versus a conventional approach of turning the lights on and off when entering and leaving the data center. The diminished life exacerbates the second, bigger problem with fluorescent lamps—they need to be maintained. The average life of a fluorescent lamp is as little as 7,500 hours and, as mentioned earlier, decreases with the number of starts. With hundreds of lamps in a data center, maintenance becomes a constant and costly process. Once a fluorescent lamp is replaced, it can't simply be thrown away. It must be disposed of as hazardous waste to prevent mercury from getting into the environment. If a tube breaks, there is the challenge of getting those materials out of the data center.

Most fluorescents are not deployed with dimming capabilities. They are either on, full power, or they are off. In fact, dimming, like turning them on and off, also diminishes the life of the fluorescent lamp. There may be situations where low lighting is completely adequate, but fluorescents are limited in their ability to dim to a low output. Finally, they're not the most energy efficient lighting platform. LED lighting has surpassed fluorescent lighting in energy efficiency and lighting quality.

The ANSI TIA-942-A standard[3] recommends the use of LED fixtures over fluorescent options in data centers for three reasons: they consume less electricity, they generate less heat and they are nearly 100 percent dimmable. Many data center managers will balk at LED fixtures due to their perceived higher cost. However, LED fixture prices are continuously dropping and, because LEDs have a longer life, typically 50,000 hours or more and don't use bulbs or ballasts, maintenance costs are considerably less than with fluorescents. Another benefit of reducing the amount of energy used for lighting shows up in HVAC costs. For every three watts reduced in lighting, there is a corresponding one watt reduction in HVAC load. The combination of better efficiency, lower maintenance costs, and declining prices, make LED lights an easy choice for data centers.

2 - The Fluorescent Lighting System - http://nemesis.lonestar.org/reference/electricity/fluorescent/lamps.html

3 - TIA Approves 942-A Data Center Standard, Cabling Installation and Maintenance - May 1, 2012

Not all LED fixtures are created equal, however. While the advantage of using LEDs is obvious, there is still one more wrinkle. LEDs are direct current (dc) devices. To operate, they need a transformer or driver that converts ac line voltage to dc power. This process of conversion occurs at the driver, which is usually a part of the fixture. When energy is converted, energy is lost and it is transformed into heat. This heat is dissipated from the driver into the surrounding air. For a data center, this means more heat in the facility and greater load on the HVAC. However, there are fixtures available that do not have drivers. These fixtures are connected to a central engine that provides power conversion and control, like the Redwood engines used in Facebook's data center. By performing the conversion at the engine, low-voltage Cat 5e/6/6a cabling can be used to run power to the fixtures, thereby avoiding the expense of deploying ac line voltage cabling. Another advantage of performing power conversion at the Redwood Engine is it takes heat out of the aisles.

Let's review how we got to the most efficient lighting. We only put lighting where it was needed by using follow-me lighting. We used the most efficient lighting available – LED lighting. We used driverless LEDs and put the power-conversion and control in a central engine and made the LEDs even more efficient. As a side benefit, we reduced our maintenance costs, disposal costs, and our HVAC load.

Many operators operate under imprecise assumptions of how long the lights are on in their data centers. However, since they're not there to monitor the lights all the time, these assumptions can be quite inaccurate. Fortunately, there is an inexpensive tool to determine exactly how much lighting energy is used in their data center. This device is a HOBO U9 Light On/Off Data Logger. By placing the HOBO in the data center an operator can track precisely how much lighting is used over a period of time. This empirical information can be used to guide data center operators to select the approach that works best for them.

The bottom line is that a data center using follow-me lighting will be more efficient than a lights-off data center. When coupled with an energy efficient lighting source, the benefits are even greater.

An intelligent lighting network solution offers a more efficient way

CommScope's Redwood solution offers a unique solution that combines low-cost LED lighting with an integrated intelligent sensor network to optimize efficiency throughout the data center. Redwood offers a number of key advantages.

By combining multiple sensors for motion, lighting, energy metering, and temperature in a single device, Redwood's sensor can be deployed at each and every light fixture, creating a dense grid with coverage for every 100 square feet of building space. This density provides an infrastructure capable of truly comprehensive sensing, reporting, and environmental monitoring.

With the comprehensive sensor network, several applications can be deployed. Follow-me lighting, introduced earlier, is simply an embedded script that takes motion detection and feeds it back to an action, turning on a light. Simply put, follow-me lighting can't be implemented without a comprehensive sensor network. Another application is security. Now that sensors can detect where people are, alerts can be generated when people enter areas where they are not supposed to be, or do not appear where they are expected to be.

The intelligent lighting network solution monitors and controls the lighting behavior based on input from the sensors and preferences set by the administrator. This smart platform has the extensibility to communicate over an IP-network through an application programming interface (API) with applications built on top of it by partners and customers, as well as the ability to monitor other systems through BACnet building automation protocol, providing efficient, centralized monitoring and management.

Finally, if the system is powering and controlling the lights, it should also be able to measure the power it consumes. That's an important requirement for data centers and something that is inherently built into CommScope's Redwood solution. Not only can data center operators claim to reduce energy, they can track it without the need for an additional power-monitoring device.

We've established that the most effective way to light a data center is to use LED lighting with centralized power and control and follow-me lighting. Because there are sensors at every fixture, the Redwood solution collects that sensor information and extends the information to other systems to deliver a platform that provides an optimally efficient way to improve productivity, enhance efficiency and reduce energy costs.

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