DaintreeNetworks

ControlScope®
Smart Building Solutions

Making Buildings Smarter

Software and wireless networking innovation that delivers fully connected, responsive and intelligent buildings

Responsible for more than 40% of the world's energy consumption, inefficient buildings are becoming the subject of stringent government regulations, utility incentive programs and green building certifications, creating an opportunity for real change. Daintree Networks® is bringing intelligent control to commercial and industrial buildings, with ControlScope®—the industry's first open standards-based solution for networked wireless building control.

ControlScope is based on an open architecture with seamless interoperability designed to work with a rapidly growing ecosystem of partner products and systems.

ControlScope delivers:

- Energy savings with significant operational efficiencies across lighting, HVAC, plug load, fans and more
- Centralized enterprise management, remote monitoring and control
- Visibility into energy usage, trends and insights to optimize operations
- Automated demand response, superior comfort and lower maintenance expense
- Scalability to grow from one application to many across a portfolio of buildings
- A platform for Enterprise Internet of Things™ (E-IoT™) applications

ControlScope solves some of the building automation industry's toughest problems by eliminating wiring—allowing broader and more flexible control, reducing costs, making commissioning simple, and extending the benefits of lighting and building controls to retrofits and new construction markets.

Simple, Smart, Scalable

Future-proof solution based on true open standards

Open standards drive customer adoption by offering choice, speed and lower project costs. ControlScope is a multi award-winning, open standards-driven wireless network solution for building control and operation. The solution consists of three layers – advanced mesh networking to provide local connectivity, sensing and control; software for easy commissioning, centralized management and data analytics; and end devices. This architecture ensures a scalable, easy to deploy and easy to use solution that offers interoperability to help customers future-proof their facility.

Replacing dedicated control wiring and physical control panels, the ControlScope-powered mesh network enables connected devices to communicate with each other wirelessly, drastically reducing total equipment, installation, and commissioning project costs.

The ControlScope Manager console provides a single, unified interface into buildings, allowing facility professionals to quickly gain real-world insight into building operations, and make better data-driven decisions while keeping work environments productive and comfortable.

The result for building owners and managers is a simple, smart and scalable control solution for a single facility or a portfolio of buildings, and it is more cost effective than ever before.

Unique ControlScope Features

- Multi-application control from a single platform
- Energy analytics, reports and insights
- Automated alerts, fault detection and alarm notification
- Multi-facility management from a central location
- Cloud-based or on-premise deployment

Single Solution for Multi-Application Control

Monitor, control and manage multiple applications

Daintree Networks is the only company to offer an integrated solution for lighting, HVAC, plug-load control and more, with open standards. Daintree's ControlScope is the industry's most intelligent, comprehensive and cost-effective control, monitoring, and optimization solution for facility, operations, energy, and sustainability professionals. The flexible solution allows customers to deploy a lighting only solution or a suite of control applications that range from thermostat, plug–load, exhaust fans, environmental monitoring and more .

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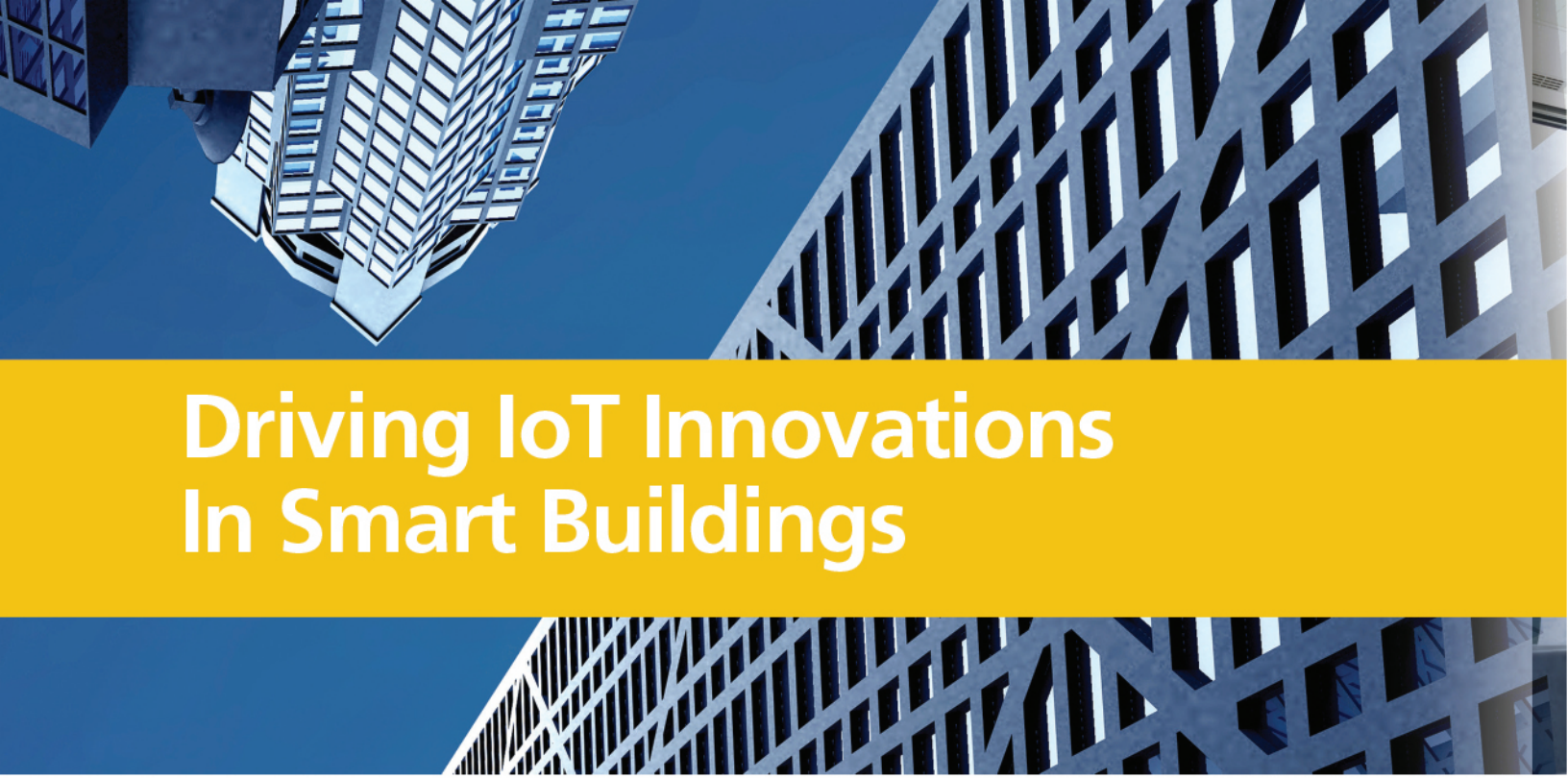
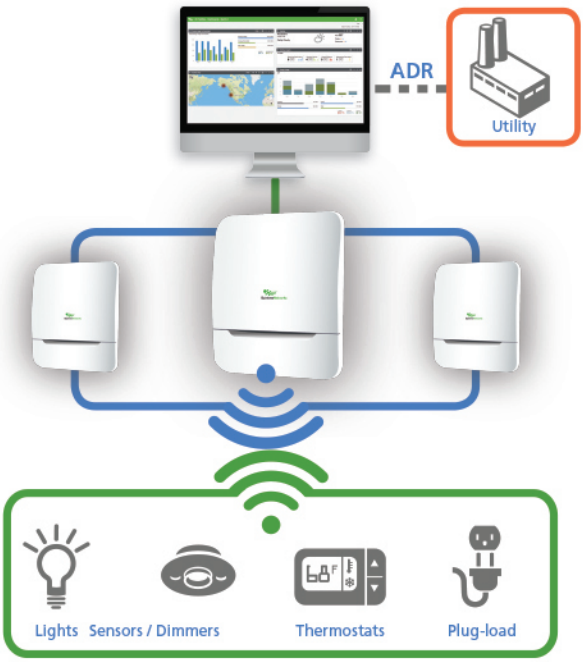


Driving IoT Innovations In Smart Buildings

Enabling the Enterprise Internet of Things™ (E-IoT™)

In the era of smart buildings, the 'building' is the enterprise and smart building control solutions are the core application and foundation for the E-IoT. The networked control solution becomes the platform to connect many devices in the enterprise, such as lighting, thermostats, electrical plugs, and other devices to enable energy savings, operational efficiencies, safety and productivity, along with reduced greenhouse gas emissions. Leveraging Daintree's E-IoT approach, the ControlScope solution utilizes sensors to monitor other conditions, such as air quality, humidity, building security and more that comprise the networked ecosystem of an organization.



Code Compliance With Deeper Energy Savings

Improve long-term sustainability and qualify for utility and government rebates

ControlScope turns regulatory requirements (for Title 24, ASHRAE 90.1, and others) such as automatic daylighting and automated demand response into simple-to-implement best practices for maximum savings.

ControlScope Building Energy Management as a Service **(BEMaaS℠)**

Cloud-based solution is scalable, cost effective and flexible

Leveraging the power of cloud computing, BEMaaS℠ offers total control over energy costs, removes the complexities of energy management systems and brings smart control strategies to your facility at the lowest installed cost.

Daintree Networks BEMaaS offers:

Lower Cost - No upfront investment, just pay as you go for lower total cost of ownership (TCO)

Lower Risk - Subscription-based cost structure requires no lump sum investment and much lower overall costs than on-premise deployment

Reduced Burden On Customer IT - Hosted software, means no software installation, no hardware maintenance and no configuration

Faster Deployment - No capacity or location planning are required; and you receive automatic software upgrades at no cost

Optimal Budget - Shift capital expenses into operating expenses; get the same level of service with better cash flow and a leaner balance sheet

Enterprise Management - Flexible solution affords the ability to scale rapidly

About Daintree Networks

Daintree Networks leads the market in smart building control, sensing, and Enterprise Internet of Things™ (E-IoT™) applications. ControlScope®, the company's open networked wireless solution for lighting and building control, monitoring, and optimization, reduces energy and operating costs, improves the occupant experience, increases business productivity and scales to manage a large portfolio of buildings.

Leveraging a wireless mesh network, the solution consists of three layers – Software for easy commissioning, centralized management and data analytics, networking to provide local controls, and end devices. This architecture is scalable, easy to deploy and use, and interoperable. Plus it is future proof, providing the platform for emerging best of breed E-IoT applications.

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Salk Institute Achieves Tremendous Energy Savings

Daintree's ControlScope® Solution Automates Lighting Reduces Lighting Demand

Location: La Jolla, California
Industry: Biological Research

Challenge:
Lighting Control
Operational Visibility
Remote Monitoring

Solution:
Daintree ControlScope®

Result:
Over 14,576 KWh Energy Savings per week
$2,900 weekly savings
77% Energy Reduction
Accurate visibility into energy usage and savings
Opportunities for Plug-Load control

77%
Energy Reduction

Business Challenge

The Salk Institute for Biological Studies is an independent, nonprofit, scientific research institute located in La Jolla, California. It was founded in 1960 by Jonas Salk, the developer of the polio vaccine whose mission was to dare to make dreams into reality. The Institute consistently ranks among the top institutions in the US in terms of research output and quality in the life sciences arena. In 2004, the Times Higher Education Supplement ranked Salk as the world's top biomedicine research institute, and in 2009 it was ranked number one globally by ScienceWatch for neuroscience and behavior.
In 2015 the Institute embarked on a pioneering journey to reduce its lighting demand. The key requirements were:

- Lighting control without compromising research
- Technology longevity
- Flexibility for future expansion

Solution

Based on recommendations from FSG (Facility Solutions Group), the Institute's vendor for Lighting and HVAC systems, Salk's facilities group looked into Daintree's ControlScope® offering. A thorough analysis based on trials of alternative solutions proved that ControlScope had the lowest installation cost, offered the most comprehensive control and had an intuitive user interface. Furthermore the fact that it is based on open standards was crucial to the Salk team since it delivers a future-proof solution.

Daintree was the only company to offer multi-application control of lighting and other building control systems and hence it was selected to be deployed at the 600,000 square foot facility. "ControlScope offers the ability to put the facility to sleep once employees go home and wake it up before the employees are back for normal business hours, delivering automatic energy savings," said Tim Ball, Senior Director, Facility Services at the Salk Institute.

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"Daintree's ControlScope provides wireless control and real time energy consumption enabling the Salk Institute to measure, manage and optimize energy and embrace efficiency".

Tim Ball
Senior Director, Facility Services
Salk Institute

Quality of Light and Control

Deploying a lighting control system often involves elaborate wiring that takes days to install, causing operational disruption and customer inconvenience which is not acceptable in a research environment. Daintree's wireless solution eliminates complex wiring, installs quickly and delivers about 50% cost savings over a hard-wired solution. The lighting control ensures the quality of light is consistent and ensures comfort without impacting research in the facility.

Real-Time Visibility into Energy Consumption

Before deploying the Daintree solution, the Salk facilities group relied on monthly utility bills to track energy consumption. This reactive approach was causing unnecessary waste and leading to an excessive energy bill. With ControlScope, facility managers are able to monitor the site remotely; they have granular detail down to the individual device and can take action immediately based on real-time information and reports.

Business Results

Daintree's Networks has helped the Salk Institute achieve its goal of deploying a future-proof building energy management solution. ControlScope has delivered over 14,576 KWh in energy savings per week. The solution helped the pioneering research institute to achieve efficient lighting and has exceeded cost saving goals.

Next Steps

The Salk Institute is planning to use ControlScope to manage all lighting at their La Jolla site in California. The Institute has plans to leverage ControlScope solution for additional applications such as plug load and fan control.

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OHL Enjoys Improved Productivity, Safety & Comfort

Daintree's ControlScope® Controls Lighting and Thermostats in State-of-the Art Retrofit

Location: Granite City, Illinois
Industry: Third-Party Logistics

Challenge:
Lighting Quality
Employee Comfort
Utility Costs

Solution:
LED Lighting Retrofit
Programmable Thermostats
Daintree ControlScope®

Result:
85% Energy Cost Savings
Improved Employee Comfort
Enhanced Safety
Greater Productivity

OHL (Ozburn Hessey Logistics) is one of the largest third-party logistics companies in the world, providing integrated global supply chain management solutions, including transportation, warehousing, customs brokerage, freight forwarding, and import and export consulting services. Founded in 1951, OHL has more than 36 million square feet of flexible warehouse space.

Business Challenge

At the 300,000 square foot facility in Granite City, Illinois, two thirds is laid out as rack aisles and one third is open warehouse. This facility operates 100 hours per week, 52 weeks a year and its high-pressure sodium lights were a drag on employee comfort and productivity. The lights did not provide good color resolution and required an employee to turn them on 15 minutes prior to opening the warehouse so they could warm to full intensity.

The lighting caused eye-strain, and the inspection of certain products prior to re-packaging often had to be done outside because the yellow sodium lights prevented employees from spotting damage.

The building thermostats also had to be turned on and off manually, which meant if it was too hot or cold when entering the building it took about an hour to reach a comfortable temperature.

Solution

Enter Richard Gedmin of Superior Solutions Group, a Daintree VAR. Gedmin knew that retrofitting the lights and thermostats with controls would solve OHL's problems and deliver significant ROI. "Richard arranged a site visit to a similar facility and after seeing their Daintree lighting and system capabilities we knew this was the direction we wanted to go," said Dana Heflin, VP Operations at the OHL facility.

85%
Energy Cost Savings

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"Our operations change with some frequency so being able to adjust light levels and behavior based on current needs is something we didn't realize was so useful. If anyone is in the market and could see this system in action, it's a no brainer!"

Paul Stepanek
Operations Manager

"Installation went very smoothly despite it being the busiest time of year for us. We are very happy with the end result and how it was executed,"

Dana Heflin,
VP Operations

Superior Solutions Group installed 398 dimmable LED High Bays equipped with the Daintree WHS100. In the offices, 120 dimmable LED Troffers were installed and controlled via the Daintree WA100 on a circuit level. Programmable WTS10 Daintree thermostats were also added throughout the facility.

The Results are Eye Opening

The Daintree system allows workers to adjust light levels for different types of work. "Under the old lighting, eye strain was something we all had to deal with. After the retrofit the consensus is that it's easier for us to perform our jobs better," commented Chris Mcintyre, an Operations Lead.

Safety First

Aisle fixtures come on as one path so the way forward is lit, as opposed to traditional occupancy sensors, which typically have a delay so that the aisles remain dark ahead. Now, forklift operators can not only see if anyone is in the aisle, but also read the product print on the top racks from the ground; a major plus for operational efficiency.

Employee Comfort

Some office workers sit by windows so being able to adjust light levels based on how much the sun is shining helps improve comfort at their desks. Plus the new thermostat controls ensure the ideal temperature at all times.

Business Results

OHL received a utility incentive of $70,000 for reducing wattage and adding occupancy sensors. Before the lighting and HVAC retrofit the average weekly lighting and HVAC energy bill was $1,600. Since then it has been slashed to $250!

Next Steps

Both Executives and workers at the Granite City facility have high praise for the Daintree solution and OHL has plans to evaluate other facilities for lighting and thermostat retrofits with Daintree controls.

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White Paper

Taking Control: 14 Energy-Saving Control Strategies for Commercial Lighting and Beyond

www.daintree.net

Executive Summary

Lighting Controls have a tremendous capacity for saving energy and money within commercial buildings. About $200B is spent globally on lighting energy each year, around half of which comes from commercial buildings. And yet, much of that energy is still wasted – lights are left on in unoccupied areas and rooms are consistently over-lit, even when technology tools exist to solve these problems.

A common misconception of a "lighting controls solution" is that it is simply an occupancy sensor, turning the lights in a single room on and off. And while this can certainly save energy and money, it's only the simplest one of many controls **strategies** designed to provide more intelligent, sustainable buildings. Today's lighting controls systems have moved beyond the stand-alone occupancy-based products, to provide true system-level control over lighting. If properly applied, the result can be tremendous savings, better occupant comfort, improved building management, and more.

The purpose of this white paper is to describe 14 distinct controls strategies enabled by today's most advanced lighting controls systems, and discuss the technology attributes that are required in order to take advantage of these strategies. Only by utilizing technology that is **intelligent, wireless** and **open** can lighting controls solutions provide the most comprehensive savings and control.

Types of Lighting Controls Systems

There are a myriad of lighting controls technologies, systems, and components on the commercial market. Generally, though, lighting controls can be divided by capability into "simple" or room-based controls, and "advanced" or networked controls. For the purposes of this paper, we can further divide the advanced category into "traditional" advanced systems – wired and proprietary – and the new generation of open, wireless controls. As we will show, these distinctions are more than academic – they represent substantial differences in capabilities and potential savings.

Simple Controls: Most lighting controls installations today still fall into the category of simple, room-based controls. These solutions are not true lighting controls systems, but rather individual components that provide a single lighting control strategy. As an example, an individual occupancy sensor can be connected via low voltage wiring to a set of light fixtures in a room, and this process can be repeated in the next room and so on. The result is to add automated occupancy control to each of those rooms, individually. The same process can be repeated with other controls components.

Centralized Controls: The next step up in capabilities is a centralized control system – for example, a lighting panel or a Digital Addressable Lighting Interface (DALI)-based solution. In these systems, each lighting element (sensors, wall switches, fixtures, etc.) is hard-wired back to a centralized controller, panel or computer. In other words, lighting in these solutions is controlled as a system or network.

These systems typically combine a discrete set of controls capabilities (or "strategies") such as scheduling, occupancy, daylighting, etc., and provide a physical interface for controlling any device hard-wired to the panel. Such systems are often proprietary, with a single vendor providing both the controller and the devices being controlled (which are only compatible with each other).

Next Generation Controls: The next generation of control systems builds upon the advantages of advanced controls but removes the limitations. Wireless networking enables larger-scale systems with controls that can be accessed from anywhere, and adjusted without physical wiring. Open standards eliminate the restrictions of proprietary systems, enabling a single controls system to utilize control devices from a variety of vendors. Integration with non-lighting products enables savings that go beyond lighting, into areas such as HVAC and plug loads. The result is an even more comprehensive set of energy monitoring and management tools, with centralized control.

Advantages of Advanced Controls

In short, more advanced controls equate to greater financial savings. Each individual controls strategy alone brings savings; when applied together, though, these savings stack. For example, while a room might reduce lighting energy usage by 30% through occupancy sensing, that same room could save 60% by using occupancy sensing, daylighting and scheduling at the same time. And several control strategies can only be implemented with an advanced, networked system, making such systems a requirement in order to realize the greatest savings.

Savings from lighting controls can come from several sources. The primary source is reduction in energy usage. The purpose of the most commonly-adopted control strategies (occupancy sensing, scheduling, etc.) is to eliminate unnecessary lighting, thereby reducing energy usage and saving energy costs. Savings in some advanced systems can also come from other sources as well – for example, by reducing lighting maintenance requirements or reducing the time and labor associated with managing lighting. And of course, government and utility incentives tend to reward greater energy reduction, providing even more savings.

Savings from lighting controls systems are also not static – they change over time. With more basic installations, energy savings tend to shrink over time, as the original design of the solution diverges from the current needs of the building and its occupants. More advanced systems can "self-correct" or adapt to retain value over time. And the most intelligent systems can actually improve their value over time, by automatically recognizing potential areas of energy savings and improvement. Finally, open standard systems offer the ability to add new capabilities in the future that go beyond lighting, for even greater value over time. These applications will be discussed later in this paper.

The intelligence of advanced controls systems provides other benefits that basic controls cannot offer, above and beyond simple financial savings:

- **Greater centralized control:** For many building owners and operators, gaining centralized control and visibility over their lighting and other energy loads is a benefit in itself, offering better management and reporting.
- **Occupant comfort:** The most intelligent lighting controls solutions enable lighting that automatically or manually adapts to each occupant's needs, for greater comfort and productivity. Balancing savings with comfort is a critical function that requires an adaptable system.
- **Green certifications:** Advanced controls systems can provide valuable points and credits towards LEED and other similar programs, above and beyond the credits that basic controls offer.
- **Regulatory compliance:** Regulatory measures such as ASHRAE 90.1 and California's Title 24 are increasingly requiring more advanced lighting controls measures. Over time, basic controls technology will no longer be sufficient to meet building codes.

Controls Strategies

Below, we will detail all of the common energy-saving lighting control strategies available today, as well as several emerging strategies and those that extend beyond lighting. These are organized generally from most common to most innovative.

Common Lighting Controls Strategies: These strategies form the core of most lighting controls systems.

- **Dimming:** Although not always considered a true controls strategy, dimming technology is utilized in several other strategies. Many lighting power supplies (e.g. ballasts, LED drivers) enable fixtures to be dimmed. Dimming the light to a fraction of its brightness will also use a fraction of the energy, allowing for many of the following strategies to reduce energy usage. The exact relationship between the brightness and the power used depends on the unique profile of the power supply. In its simplest form, dimming fixtures are paired with a dimmer switch, for manual dimming control. Dimming capabilities vary widely, from step functions up to full, smooth control over precise light levels.
- **Occupancy sensing:** This is perhaps the most common of all lighting controls strategies. A motion sensor (also known as an occupancy sensor) detects movement within its field of coverage, using Passive Infrared (PIR), ultrasonic, or other sensing technologies. Based on movement detection (or lack thereof) for a pre-defined period of time, lights can be automatically turned on or off. In this way, lights can be automatically turned off when a space is not in use.

  More sophisticated controls solutions allow occupancy settings (such as on/off levels, time delays, etc.) to be dynamically set or changed based on time, location and other inputs. Occupancy sensors can be built as stand-alone devices, or integrated directly into wall switches, light fixtures, furniture and more.
- **Scheduling:** Scheduling is another method of eliminating unnecessary lighting usage when building occupants are not present. Most centralized lighting controls systems provide some form of lighting schedule, the simplest example being a system that automatically turns off the lights after work hours. This is a "brute force" method of reducing energy usage, but can be effective. Some systems allow local user override of the schedule (via a wall switch), and the more sophisticated systems can create more complex schedules that alter other strategies based on time of day, day of week, time of year, etc.

Advanced Lighting Controls Strategies: These strategies are not as commonly used as those above, but are becoming more widely available.

- **Daylight Harvesting:** Also known as Daylighting, this is the practice of automatically reducing artificial light levels when ambient daylight (from windows, skylights, etc.) is available. Daylighting systems typically utilize a photocell sensor (though alternate sensor technologies do exist), which measures ambient light. Based on the reading from the sensor, an algorithm will determine the appropriate level of artificial light, or whether the lights can be turned off altogether, and the control system will take action. A properly-designed daylighting system can provide substantial savings in window-facing areas.

  Daylighting can work effectively with both dimming and non-dimming lighting, and like occupancy sensors, photocell sensors come in a variety of forms and can be integrated into other products. A similar concept is commonly used in outdoor lighting, where integrated photocell sensors automatically switch lights on at dusk and off at dawn.

- **Task Tuning:** This strategy goes under several names. The core concept is to reduce the maximum light output of each individual space to precisely meet occupant needs. Because light levels are often over-designed, or made consistent across a building despite the different needs of occupants, many spaces are over-lit. Some control systems offer the capability to create lighting zones and determine a "tuned" maximum light level that is lower than 100%. As an example, an occupant working with a computer monitor all day may not need the designed light level, and their area could be tuned so that the maximum level is 70%.

  The related concept of Lumen Maintenance stems from the fact that most lighting experiences a slow depreciation of light output over its lifetime. In this scenario, light levels are tuned down initially, but over time the control system slowly tunes levels back up to account for depreciation and maintain a constant output.

- **Demand Response (DR):** This strategy is less about saving money, and more about earning money – by reducing peak energy demand at key times, and being reimbursed by utilities to do so. A major goal of many utility companies is to better distribute their load, reducing the demand for energy at the times of highest demand (such as hot summer days). Lighting controls systems can help by reducing lighting load during those times, in response to a signal from the utility. Some controls systems offer Auto-DR technology: the ability to respond to a DR "event" and reduce light levels automatically. Demand Response utility programs vary widely, but some offer significant reimbursement (such as $300 / kW) for making a building's load available for reduction.

- **Personal Control:** Various studies have proven the positive impact of a worker's environment – and their control over that environment – on their productivity and happiness. It has also been found that when occupants are given personal control over lighting, their energy usage tends to be lower. Advanced lighting controls systems can use various forms of personal dimming to provide this control, ranging from remote controls to desktop dimming switches to "virtual" switches online, on a desktop computer or on a phone.

- **Energy Management:** This strategy typically refers to a software system that enables a building or facilities manager to visualize, report on and adjust their energy usage. It is often said that you cannot manage what you cannot measure – and centralized energy management software tools provide the capability to do both, in order to test and measure the success of lighting controls.

  Energy management saves energy over time by providing ongoing improvements to all of the other controls strategies. As an example, analysis of building energy usage compared with occupancy data over a month might point out that the office's kitchen area sees occupants throughout the day but only for short periods of time. The system could recommend reducing the occupancy-based off-delay in this area from 15 minutes to 5 minutes, and would measure the additional savings of that action. This type of ongoing recommendation and improvement is also known as Continuous Commissioning.

Lighting-Related Controls Strategies: These strategies begin to extend beyond the standard goal of reducing lighting energy usage, and provide other lighting benefits.

- **Automated Maintenance:** By monitoring and measuring energy usage at individual fixtures, some control systems can provide the capability to know when a lamp is out, or a sensor or ballast is malfunctioning. Likewise, similar information can be used to make an educated guess about when maintenance will be required. Finally, some systems can manually or automatically reconfigure in the case of a failure – for example, if an occupancy sensor fails, the lights can be re-associated with a neighboring sensor until maintenance replaces it. Together, all of this information can be used in an energy management system to improve the scheduling of maintenance calls, reducing the frequency (and cost) of lighting maintenance.

- **BMS Integration:** Some advanced lighting controls systems enable integration to a facility's Building Management System (BMS), typically via BACnet or another open protocol. Through this integration, the user interface of the BMS can provide integrated control and management functions. Although this strategy doesn't save additional energy in itself, it does offer reduced management overhead (and the associated lower cost) for buildings that want to manage HVAC, lighting and other functions from a single console.

Beyond Lighting: These strategies extend a single control system beyond lighting, to control (and reduce) other common energy loads.

- **Plug load Control:** Plug loads are an area of energy usage that is rarely controlled, but represents a significant amount of energy waste. Under this strategy, devices that would be plugged into a standard plug strip or outlet (such as monitors or desktop lamps) are instead plugged into a specialized "plug load controller". These loads can then be managed according to a schedule or associated with an occupancy sensor. For example, a plug load controller can be set to automatically turn off a desk lamp at the end of the day and whenever the user leaves his desk. This reduces both wasted usage and the "vampire power" that some devices draw even when off. Generally, wireless plug load controllers that are part of a centralized solution offer more sophisticated control options than standalone controllers.
- **Temperature, Humidity, CO2, and other Environmental Monitoring:** One of the advantages of a centralized control system (especially wireless and standards-based systems) is the ability to add applications onto an existing network without the need to build out a new dedicated infrastructure. Several emerging applications take advantage of environmental monitoring sensors, to report on conditions in a facility and trigger alerts if those conditions exceed a threshold. For example, some data centers closely track temperature and humidity to avoid unplanned outages. In a lighting controls solution that supports this application, temperature and humidity sensors can be added to the network and report real-time data.
- **Wireless Thermostats:** Building Management Systems typically manage the thermostats and other HVAC devices within the building. As those devices have begun to roll out with wireless communications capabilities, though, buildings have balked at the requirement to build a dedicated wireless network just for thermostats. A wireless lighting controls network can be used to avoid this requirement, routing wireless control messages to and from the thermostats via the lights. The benefit is a single building control network, eliminating the cost of building separate parallel networks. Lighting serves as an especially robust "base application" for this network, due to the large number of lighting nodes (e.g. fixtures), and their even, distributed coverage throughout the building.
- **Other Independent Building Systems:** As with the environmental sensors above, some standards-based controls systems have the capability to add control over a variety of other devices. Some examples include automated window blinds, industrial fans, and security systems. By providing centralized control over these devices in addition to lighting, these advanced building networks can provide greater control from a single integrated solution and interface.

How to Take Advantage of the Most Advanced Control Strategies

As detailed at the start of this paper, not every controls system enables all of the above strategies. While most systems offer a subset, many are constrained due to their choice of technology, making some of the most valuable strategies impossible to implement. For example, a lighting controls system that isn't networked will not be able to provide a centralized control interface – it is a basic limitation of the technology architecture.

In order to get the most out of a potential controls system purchase, and enable all of the above strategies, here are some of the key attributes to look for:

Networked: A networked architecture is what separates basic "room-level" controls from true control systems. Without some form of networking (wired or wireless), it is impossible to take central control over lighting and therefore impossible to take advantage of energy management, demand response, and many other controls capabilities. Non-networked controls are also extremely difficult to manage, maintain and upgrade.

Intelligent: Many controls solutions tout "intelligence" as a feature – and it is a critical one, but difficult to define precisely. In practice, intelligence in a controls system typically means a combination of multiple related attributes:

- Flexible configuration, allowing facilities managers and other users to more accurately adapt to conditions and occupant needs. In other words, an intelligent controls system usually includes a powerful and feature-rich user interface for setting or changing controls.
- Automated controls algorithms that make decisions based on multiple inputs. For example, an intelligent controls system could combine ambient light readings with time of day, day of week, location, user preference and more to determine (and set) the appropriate light level.
- The ability to measure results, and the means to use that information to improve results.

Simply having access to multiple controls strategies does not necessarily make a system intelligent –sophisticated software is required in order to determine how those strategies should interact. It is important to look in-depth at a system's capabilities and how it logically makes decisions, in order to determine if it meets your needs.

Wireless: As the number of end points in a building control system has proliferated – lights, various sensors, wall switches, remote controls, computers, plug load devices, and more – so has the complexity of reaching and communicating with each of these devices. In order to effectively control a device, the central system must be able to communicate with it. Wired systems bridge this gap with dedicated control wiring (or specialized power-line control wiring), but the more devices in a system, the more complex and inflexible this becomes.

Wireless networking is an effective solution, eliminating limitations of which devices can be controlled, where they can be placed, and so on. This is especially critical in order to realize the most advanced control strategies, and those that extend beyond lighting. Most wired systems, for example, were not designed to connect to plug load controllers or environmental sensors, so there is physically no way to add that capability. Wireless systems can connect to such devices easily, as long as they speak the same language.

Open: As noted above, communications is a requirement of any controls system – the system must be able to receive data from devices and issue commands to fixtures. But what "language" is used for these control messages? It can take many forms, though most frequently the communications language is proprietary, and created by the manufacturer of the controls system. For example, a controls manufacturer could create a sensor, a ballast and a control panel, and write the language they use to communicate with each other. If a customer tried to use another vendor's sensor with that panel, they would not be able to understand each other and would be unlikely to work together.

Proprietary systems have limited the growth of new and innovative control strategies, because each vendor essentially starts from scratch in developing their own system, and has the added overhead of upkeep on their proprietary communications protocol. This is changing with the introduction of "open" systems to the lighting controls market, based on well-accepted industry standards. In an open system, a manufacturer chooses an existing communications language, and their products can communicate directly with other manufacturers' products.

There are many positive results of open systems – choice, trust, lower cost – but perhaps the most important is their impact on innovation. Unlike proprietary systems, a standards-based control system can use any standards-compliant device. When multiple companies develop products based on the same open industry standard, customers can take advantage of all their combined innovations. This is how lighting controls systems have begun to take advantage of energy savings beyond lighting (for example, connecting to environmental sensors or wireless thermostats) and will define the future of how new integrated energy strategies will be developed.

Common Lighting Controls Strategies	
Dimming: Enable fixtures to dim, for use in other strategies below	Variable
Occupancy Sensing: Adjust lights based on occupancy detection	Up to 40%
Scheduling: Dim and turn off lights according to a pre-set schedule	Up to 40%
Advanced Lighting Controls Strategies	
Daylight Harvesting: Adjust electric light levels to take natural light into account, using photosensors	Up to 20%
Task Tuning: Reduce maximum light levels based on requirements for each space	Up to 20%
Demand Response: Reduce light levels at peak times based on automated signals from electric utilities	Variable
Personal Control: Enable individuals to set light levels to suit personal preferences	Up to 10%
Energy Management: Software for ongoing improvement in controls settings and strategies	Variable
Combined Lighting Energy Cost Savings	**Up to 70% of Lighting Energy Costs**

Additional Lighting-Related Strategies	
Automated Maintenance: Monitor lamp & ballast life to reduce ongoing maintenance costs	Up to 10% of total lighting costs
BMS Integration: Integrate lighting with a BMS for simplified building management	Variable
Additional Strategies Beyond Lighting	
Plug Load Control: Manage and schedule additional plugged-in devices through the controls network	Up to 20% of plug load energy costs
Environmental Monitoring: Measure and manage environmental data through the controls network	Variable
Wireless Thermostats: Control wireless thermostat usage through the controls network	Variable
Other Independent Controls: Add & control other uncontrolled load through the controls network	Variable

Conclusion

Today's lighting controls systems provide a more comprehensive solution with greater savings potential than ever before. The key to taking advantage of this potential is to go beyond the basic control strategies – using multiple strategies in tandem. We have described 14 strategies being used today, but there are countless emerging strategies waiting to be used and innovations yet to be discovered. Controls systems that are primed to use these new innovations are more likely to last the lifetime of your building, and continue to provide value far into the future.

About Daintree Networks

Daintree Networks is revolutionizing the way commercial and industrial buildings intelligently manage and reduce their energy use. Daintree provides the industry's leading wireless lighting controls solution, delivering substantial energy efficiency improvements and occupant-friendly work environments, all in a more cost-effective way than ever before.

Since its founding in 2003, Daintree Networks has been a pioneer in wireless mesh networking, with nearly 400 customers using its industry-standard design verification and operational support tool. The company has brought this extensive experience to bear in developing the market's first truly open and interoperable platform for wireless lighting controls. For more information, visit www.daintree.net.

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