

# NETWORK CONNECTED LIGHTING FOR COMMERCIAL BUILDINGS: READY FOR A BREAKOUT YEAR

## In 2016, Network Connected Lighting Will Drive Energy Efficiency, Productivity and the Development of Smart Buildings

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Network connected lighting is beginning to transform the lighting industry—and the industries it serves. While the concept is being used in commercial buildings, it is poised to break out in 2016, as large-scale projects get underway. Growing affordability and higher efficiencies are driving the use of network connected lighting in commercial buildings, making possible concepts such as the smart building and other applications that drive efficiency and productivity. Innovative owners of enterprises and buildings are beginning to perceive network connected lighting infrastructure as an asset that enables practical applications for the Internet of Things (IoT) and smart buildings and adds significant value to buildings and companies.

### GROWING PENETRATION

While still in an early stage, LED penetration in commercial buildings is reaching critical mass, making it cost competitive with other lighting technologies and enabling deeper market penetration.

Today, the use of LED technology in commercial buildings has moved past the innovation stage, where it had less

than 1% share of the market, to the early adoption stage, where it now has about a 3% share, according to a 2015 study by the U.S. Department of Energy. Five years from now, the penetration of LED technology in the commercial building space is expected to be close to 25%. This growth pattern matches those of other lighting categories, such as traffic signals and exit signs, where LED penetration is now in the late majority phase, defined as 80 to 90% of the market, according to the study.

### NEW CONTROL METHODS

The adoption of LED fixtures in commercial buildings is accelerating interest in network connected lighting because more efficient and higher performance control makes it more affordable in commercial buildings. To date, the lighting industry has focused mostly on retrofitting existing lighting fixtures with LEDs to replace older technologies, such as fluorescent and compact fluorescent lighting. Controlled LED, however, not only improves efficiency but also provides better light quality, smoother intensity/dimming control, and dynamically adjustable color temperature, providing the right light when and where

it is needed. This results in augmented worker comfort and more interactive and purposeful lighting and spaces for people. The ability to migrate lighting control to network IP-based infrastructure makes lighting a service and an IoT building asset that can be controlled synergistically along with other building functions.

It is important to note the difference between smart lighting and network connected lighting. Smart lighting doesn't necessarily need to be connected to a central network, and can be implemented simply by retrofitting older lighting fixtures with individual LEDs and sensors capable of simple, local control. Network connected lighting, on the other hand, requires a centralized, software-based control system that coordinates all the elements in the lighting system, including luminaires, sensors, actuators and other devices. Lighting infrastructure is always present in a building and it's very granular. More integration means not only better control but also more data and information being collected by a distributed sensor system as part of the lighting network.

These data have the potential to open up

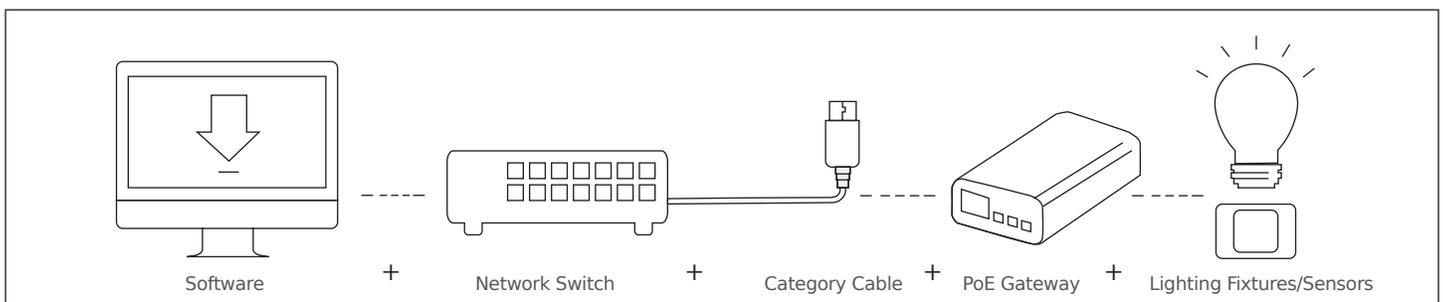


Figure 1: A schematic of Transcend® Network Connected Lighting, a PoE lighting system. Transcend comprises software, networking technology, category cables, sensors, a PoE gateway, and lighting fixtures from various manufacturers



a new value proposition for commercial buildings. The first application is, of course, real-time energy usage reporting, but other applications—such as sensor-based occupancy reporting, light status and environmental monitoring—provide an entirely new view into how commercial buildings are used. By analyzing this data, we will be able to know how many people are in the building at given times, where they are located, how spaces are being utilized, the condition of those spaces and how usage of different areas of multi-floor and multi-building campuses compare to each other. All told, network connected lighting will dramatically accelerate the integration of the IoT into commercial buildings.

**NEW DEPLOYMENTS**

New commercial buildings are the best candidates for network connected lighting systems, which can be designed as part of a building’s infrastructure, but deep retrofit projects are appropriate as well. There have been significant pilot installations of network connected lighting in commercial buildings, but in 2016 there will be larger scale of installations in buildings.

Molex is starting to install network connected lighting as part of a major retrofit of a building on its main campus in Lisle, Ill. The multipurpose building, now called the “Vision Building,” will be a showcase for PoE lighting technology and the possibilities it offers. The Vision Building, which is expected to be completed in the first half of 2016, will be a space where Transcend® Network Connected Lighting from Molex will be installed and demonstrated. Transcend is a full-system network connected lighting infrastructure primarily based on PoE power and data distribution. The Vision Building will be a technology center and showcase for the entire Molex ecosystem of partners. We hope to demonstrate how network connected lighting systems, which are ready for commercial use, can improve lighting efficiency while also improving comfort, well-being and productivity.

The retrofit also includes a buildout of the “densification” concept, a change in interior building layout to include more offices

in the same square footage in an open space layout while providing more shared space, including breakout and collaboration areas. Molex and its partner companies will provide new technologies in everything from lighting to IT network infrastructure to carpeting to washrooms.

**KEY OBSTACLES**

While progress is being made in the deployment of network connected lighting systems, several obstacles to deeper market penetration must be resolved. Today, traditional connected lighting systems are difficult to design and commission. The installation, configuration and commissioning process must be simplified and standardized, which will boost adoption significantly.

Also, network connected lighting systems need to be easily understood by lighting architects, building owners, facility managers, installers and users to truly unlock the value associated with these systems. The lighting infrastructure and its installation cannot be disruptive to the management of the building. In addition, the software used to control network connected lighting systems must be very simple and user friendly.

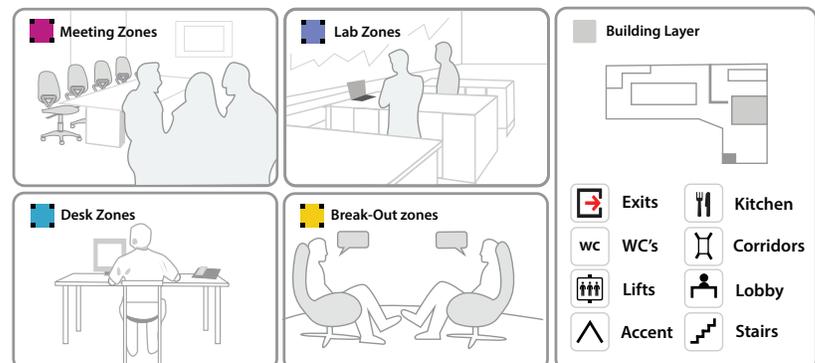
To date, the majority of installed network connected lighting systems are based on proprietary systems, but the industry needs open standards and interoperable systems that can simplify integration with the rest of the building automation network.

**NEW POWER STANDARDS**

Power over Ethernet (PoE) is one of the most promising technologies allowing IP convergence for building automation networks—including lighting—without the use of proprietary systems. LED technology requires low-voltage DC power in a different manner than older lighting sources, which utilize AC power that has been converted to low-voltage power. A smart network controlled LED lighting system requires low-voltage power distribution and data communication for the control. Power and data on low-voltage cabling is possible using the same infrastructure that the IT industry has deployed for 15 years.



Figure 2: Technology integrated within PoE lighting systems allows for full customization. End users can adjust lighting needs based on defined zones





PoE delivers electrical power over category cabling to networked devices and is widely deployed to provide power to various endpoints in commercial buildings, including VOIP, cameras, HVAC and now lighting. PoE offers high availability for power, guarantees uninterrupted service and lowers operating expenses by providing network resiliency at a lower cost by consolidating backup power. It also offers faster deployment of new networks by eliminating the need for a power outlet at every endpoint.

The driver of LED efficiency is its outstanding lighting output per watt of power, which far outstrips that of older lighting technologies. While already advanced, LED technology is becoming more versatile, efficient, secure and capable of supporting available wattages in network connected lighting systems under the IEEE 802.3xx standard. This standard has been proven as a mechanism for classifying the endpoint devices needed to establish power connections.

For example, the original PoE standard IEEE802.3af, based on 15.4w per switch port of power, has increased to 30w in PoE+ (IEEE802.3at), the current standard. However, a new de facto-standard has been developed called UPOE, which delivers 60w per switch port. The standard is due to change again soon with the recently introduced Power over HDBaseT (POH) standard, which supports over 95w per port. The IEEE is working to standardize the 60w and 95w PoE options under the 802.3bt specification, which should be completed in 2017. The technology is backward compatible and interoperable with the existing IEEE standard.

The 60w and 95w standards are based on using a four-pair power transfer format rather than the two-pair format used by the 30w PoE+ standard. The new standards improve efficiency and allow a much wider range of device support while using the same low-voltage Class D (Cat5e) cable as the PoE+ standard.

In the existing PoE+ standard, a two-pair 30w system delivers electrical power over two of the four available twisted pairs in Cat5e cabling. In this system, the pairs 1, 2 and 3, 6 are used to transport power from the PSE (power sourcing equipment)

to the PD (powered device) and the spare pairs (4, 5 and 7, 8) are idle. The 60w UPOE standard uses the same cabling as the 30w PoE+ standard, but while the two-pair system uses one PSE controller to power the PD through the signal pairs of the cable, a four-pair system uses two PSE controllers to power both the signal pairs and the spare pairs. Because it uses all four twisted pairs to deliver power, UPOE can deliver more power and is more efficient than PoE+, reducing channel losses.

### NEW LIGHTING PARADIGM

Through the development of new products and new, more efficient standards, network connected lighting is rapidly becoming a key part of commercial building design, and companies that create enabling technology for this new technology will help drive the industry through the transition.

Today, however, IT and lighting are mostly separate worlds. We need to create a bridge between these worlds, not only in terms of technology but also in the understanding of best practices for lighting architecture, construction, and installation, and best practices for the management, control and security of IT systems.

That is beginning to happen. There are lighting manufacturers participating in IEEE standard committees, and IT companies participating in lighting standard committees. The Molex Transcend® PoE Lighting System is a good example of how the IT world and the lighting/building automation world are merging. There is a transition occurring in the industry where lighting architects, electricians, MEPs (mechanical/electrical/plumbing contractors), installers, and low-voltage power and data specialists are showing great enthusiasm for PoE connected lighting systems. On average, it is estimated that PoE network connected lighting systems (and low-voltage lighting systems in general) offer between 10% and 25% capex savings compared to traditional line voltage LED lighting control systems.

Figure 3: PoE lighting system modules (top right) allow lighting designers to implement a variety of lighting methods, including directed, indirect, ambient, and decorative



The potential advantages are great. Network connected lighting can increase lighting efficiency up to 70% compared to traditional lighting control. But, as mentioned earlier, better and more effective lighting can also increase worker productivity, which can have a profound effect on company performance. For example, a 2012 study by the Rocky Mountain Institute found that the annual cost of energy in an average commercial building is about \$3 per square foot. The annual cost of a mortgage or rent on the building is about \$30 per square foot and the annual cost of salaries for the people working in the building is about \$300 per square foot. That means if the productivity of the people working in the building can be increased 1%, it will produce annual savings of \$3 per square foot, which would pay for the total cost of energy.

Studies show that better light and more natural light can fuel those improvements in productivity, as well as improvements in health and well-being. The Center for Building Performance and Diagnostics at Carnegie Mellon University identified 12 studies linking improved lighting design with 1 to 23% percent gains in individual productivity. The studies measured productivity gains through increases in reading comprehension, letter processing speed and a range of other tasks, as well as reduced absenteeism.

Also, keep in mind that, as with any new technology, potential new benefits of network connected lighting will likely emerge. As commercial buildings migrate to the IoT via IP protocol, that opens the door to big data analytics, and the long-term significance of that development as part of the value proposition for network connected lighting is just beginning to be understood.