Lighting Up LEDs  
“Out with the Romex Wire: In with Category 6 Cable”

Jim Sinopoli, Managing Principal  
Smart Buildings, LLC

The relentless penetration of IT has a long history of changing building systems; transforming analog phones to digital phones, changing analog surveillance cameras, IP-enabled access control, IPTV as well as a host of other systems. The next building system to transform to an IT structure is low voltage LED systems; it’s been in the making for a few years and led by some of the innovative companies and early adopters. It’s now at the point that we can project that the IT structure for LED lighting systems will become the new norm.

The impetus for such an IT structure is linked to the fact that LEDs are low voltage light sources. One way of providing low voltage is installing AC power and converting it to DC; this will work but adds costs, additional points of failure and generates additional unwanted heat.

Meanwhile, the IT industry has been providing low voltage DC power via Power over Ethernet (PoE) for over a decade. In 2003 an IEEE standard was published allowing low voltage power, 48 VDC, to be transmitted over an Ethernet Category 5 Twisted Pair cable. With the initial standard, the maximum that can be delivered to a powered Ethernet device is 15.4 watts, which is sufficient to power many low powered devices. A second standard, known as “PoE Plus” offers higher power levels (25.5 W of power) although still within the low voltage range. (One of the main reasons for the PoE plus was the need to provide enough power to surveillance cameras with pan, tilt, and zoom capabilities.) Tech giant Cisco introduced a 60W power over Ethernet a few years ago.

PoE has several benefits:

- **It costs less.** It is much less expensive to provide a PoE network port than it is to install conduit, wire, a backbox for an AC outlet, a transformer for conversion and the labor of an electrician. PoE significantly reduces the cost of installation and construction. Purdue University installed over 1,100 PoE wireless access points across campus, and saved $350 to $1,000 per location by not having to install typical AC power. It has also been estimated that the electrical cost to provide power to a device is about $864, while the cost of a PoE network port is around $47-$175.

- **PoE increases reliability;** PoE centralizes power distribution. Instead of a power outlet at each local device power is now distributed from the telecom rooms. Centralized power makes it easier to provide...
uninterruptible and emergency power for critical hardware such as LED emergency lighting, thus increasing system reliability and uptime.

- **End devices can be monitored and managed.** Network switches provide management tools such as the Simple Network Management Protocol (SNMP), which allow staff to manage the end devices, including power to the end device. You can remotely turn the device or fixture on or off, change lighting levels, colors, schedules, monitor energy consumption, etc.

- **Moves, adds and changes are easier.** PoE allows for slightly easier building renovations and rearranging of spaces since devices only need one cable. It’s easier to install devices on walls or ceilings and to setup temporary installations.

- **It’s an international standard.** PoE is being marketed and deployed worldwide, allowing manufacturers to avoid supplying different power cords for different countries and eliminating the need for installers to worry about power cords. Manufacturers, contractors, building owners and designers can deploy a uniform solution around the world.

- **Less high voltage used in the building.** With PoE, more low voltage distribution is used to power devices and less high voltage is used throughout a building. This results in a safer environment and lower power consumption.

This type of lighting system can allow for additional sensors, such as occupancy, temperature, automated daylight harvesting based on ambient light levels, and passive motion sensors, with all the data points shared with other building systems as appropriate. With the data from the lighting system and the building BMS, there is opportunity to create a rules-based lighting system, similar to HVAC’s fault detection and diagnostic rules, where real time lighting and environmental data can be used to optimize the lighting system or shared with other building systems.

The use of DC is important. In most buildings, including our homes, we are surrounded by devices and equipment that internally operate on Direct Current (DC). We plug these devices into a typical Alternating Current (AC) outlet, and then AC is then converted to DC, each conversion creates an energy loss. In addition many newly constructed buildings are deploying renewable energy sources such as solar or wind which can generate DC power. With the large number of DC powered devices in buildings and DC generation now utilized in many newer structures, the addition of a DC LED lighting system adds the ability to distribute DC power in buildings and maximize of the use of DC power generated by renewables.

Researchers at Carnegie Mellon University have published a paper evaluating the cost of energy for lighting systems and concluded that a DC grid is far less expensive powering LED lighting. Researchers say DC power could save $24,000 a year in a 48,000-ft² building lit by solid-state lighting (SSL).
DC infrastructure is getting traction. My colleague, Andres Szmulewicz, predicts that in less than 10 years we will have laptops and even PCs that plug into high power DC ports like smart phones or tablets do today. We are already seeing PoE to USB adapters built into face plates to provide USB ports for charging electronics.

While the approach to LED lighting systems is sound, it does come with a few issues:

First, IT contractors can certainly install an IT system, but they are neither electrical nor lighting contractors. They will need training on installing lighting fixtures. Can they handle ceiling stringer supports, mount downlights in ceilings or install ceilings supports for pendant fixtures?

Can IT understand required light levels, light distribution, contrast, color rendering, luminous flux, luminous intensity and the lighting needs of particular spaces? IT contractors may need to partner with a lighting company or develop in-house expertise. For a typical lighting control company, the reverse may be true, that is the lighting companies will need to team with an IT contractor or develop internal IT resources.

Also, many times a lighting system for new construction may go beyond just a lighting system to a comprehensive solution incorporating motorized shading and sensors for sun tracking and thermal loads. These systems have to be integrated in a way to optimize the thermal load from the windows with shades as not to have the HVAC system start cooling, as well as optimize occupant light levels. That type of complexity is way beyond simply providing low voltage DC to an LED.

Light Emitting Diodes (LEDs) are semiconductors. They can be configured in an analog mode to be used primarily in the older lighting systems, but new systems are likely to be all digital. Digital means an infinite number of colors, scenes and brightness settings and control. IT based low voltage LED lighting systems combine energy efficiency, long lasting LED lights, the use of DC power, an opportunity for additional sensors and data points to assist in managing the building’s performance, and leveraging the IT network to deploy the lighting systems. The low voltage LED lighting system seems to reflect almost everything the building industry has been talking about regarding building control systems. It will be a monumental move that is more likely to spark additional innovation.

What’s not to like?

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