High Energy to Low-Voltage: Power over ethernet brings more energy to new applications

By Chuck Ross | ⏱ *Published On Apr 15, 2021*

About two decades ago, a new technology began to revolutionize telephone services. Called Voice over Internet Protocol (VoIP), this approach moved phone traffic off telephone company lines and onto the internet. Soon, ethernet cables became the go-to connectors for handsets across corporate America, and many residential customers started paying their cable companies for their phone service, instead of Ma Bell.

Today, a similar revolution is occurring in the lighting industry, where low-voltage ethernet cabling is beginning to take the place of traditional wire and conduit in early-adopting office buildings and hotels. While the term "low-voltage" could throw up a warning flag for many electrical contractors, it also can be seen as an opportunity for expanding into a broad new category of service offerings.

Power over ethernet (PoE) is this new approach to powering and controlling light fixtures that is set to boom over the coming decade. A new IEEE standard has boosted power capacities just as low-demand LED lighting has become the dominant player. These factors, combined with a growing emphasis on lighting efficiency and controllability, have led to bullish estimates for growth. Research & Markets, a market-research firm in Dublin, sees this new industry growing at a combined annual growth rate of more than 33% between now and 2027. Other forecasters are equally optimistic.

New standards encourage growth

Lighting isn't the only application for PoE technology. It initially came to market with the rise of VoIP phone systems. The first IEEE PoE standard, 2003's IEEE 802.3af, called for a max of 15 watts (W) of power supply for every ethernet port used to supply electricity, which was adequate for telephone handsets and basic security cameras, but not much else. That limit was lifted to 30W under IEEE 802.3at in 2009, which expanded its use to include wireless access points and better cameras. In late 2018, IEEE 802.3bt raised power thresholds even farther, defining two new PoE classes that allow for 60W and 90W, respectively.

The adoption of 802.3bt corresponded with a time when LED fixture efficiency had begun climbing above 100 lumens per watt and energy codes were starting to demand new levels of lighting control. With 2x2 LED troffers drawing as little as 30W and individual downlights as little as 9W, a single 90W ethernet line now can serve multiple fixtures. This has some commercial office owners and developers rethinking how to power their lighting systems.

"We've definitely started to see a snowballing of acceptance of PoE lighting approaches," said Andrew Pospisal, director of hardware engineering for Igor Inc., West Des Moines, Iowa, which makes devices their lighting-manufacturer partners use to enable easy PoE connections, along with the software and cloud analytics used to control connected fixtures and understand their energy use.

Initially, he said, PoE buyers tended to be early adopters, but "that's completely changed, and we see a lot of new construction projects that have PoE in them from the start."

Beyond their low electricity demand, LEDs are uniquely well-positioned to take advantage of the fact that ethernet cables transmit both data and power. After all, an LED fixture could be seen as more closely related to a computer than to traditional incandescent and fluorescent luminaires.

"It starts its life as a piece of silicon, and it needs DC power to run," said Bob Cicero, business development manager with Cisco, San Jose, Calif., which developed some of the earliest PoE systems and has remained a leader in the technology's expansion.

"We also look at the control system element," Cicero said. "Clients are viewing the lighting system as an IoT (internet of things) system now—what's stopping you from putting on a lighting sensor or a temperature sensor? We're collapsing the power and control onto a single 4-pair power cable."

In fact, PoE is progressing rapidly enough that some are seeing PoE as a strong alternative to wireless, Wi-Fi-based lighting sensors and controls in some applications, according to Sasha Wedekind, managing consultant with the energy consulting and research firm Guidehouse Insights, Boulder, Colo.

"PoE lights are directly connected to the internet via a network cable, unlike wirelessly connected lighting," she said. "This means lighting performance will be more consistent, without potential Wi-Fi interferences."

Additionally, lighting moves and changes could become the IT department's responsibility rather than maintenance staff or outside contractors. Tim Milton, vice president of integrated solutions at USAI Lighting, New Windsor, N.Y., gives the example of an underused conference room to explain how this could work. Occupancy data gathered from PoE fixture-based sensors could help facility managers identify a better use for the space or decide to simply absorb that room into the surrounding open-office area. Reassigning lighting groups would only require a few software commands.

"The lighting nodes are all individually addressable," Milton said, offering a simplified description of what those commands might look like: "I want you to do something different without modifying the wiring."

Bringing it together

For electrical contractors without much low-voltage experience, developing expertise in PoE lighting installations could mean experiencing a bit of a learning curve.

"It's going to be a different environment, wiring-wise," Milton said, likening the primary elements of the PoE power infrastructure to an old-school IT room loaded with server racks. "A low-voltage installer will be part of the team, now."

Pospisal explained what installations look like under an Igor approach. They begin with a central control server for lighting controls, which would also provide the interface with cloud-based services for managing and analyzing the data generated by sensors and other connected devices. Then structured ethernet cabling would run from PoE power-source equipment, such as a network switch or a distributed power supply in larger projects, to the network's powered devices.

If you're picturing this in your head, you might be thinking PoE arrangements would result in significantly more cabling overhead than in a traditional approach, and you'd be correct, Wedekind explained.

"A PoE cable cannot run longer than 100 meters, and every connected device, such as a light, must be connected to a network switch," she said. "These two parameters mean that, depending on the number of devices connected, the amount of cabling and switch infrastructure in a building can have a significant footprint on building space and cooling needs. For example, connecting all lighting in a multistory building using PoE would most likely require a network closet on each floor."

Pospisal said that the latest IEEE standard has helped address the cabling issue by raising the power each cable can carry, and, therefore, the number of devices that cable can power. However, all the IEEE PoE standards also recognize that line losses can lead to reduced power availability at the end of longer runs. For example, IEEE 802.3bt's 90W category allows for a power drop to 71W at the end of a 100-meter run. But, Pospisal added, power performance is largely influenced by the quality of the cable specified for each project.

"What I've seen is that 71W or 72W is really a worst-case scenario," such as at the end of a 100-meter run using lower quality cable, he said. "With a 90W installation, we're recommending Cat. 6 cable with a minimum of 23-gauge copper."

Cicero agrees that the higher power-carrying capability is helping to reduce cable clutter.

"It's not one fixture from one port. We're seeing more and more devices being deployed from that ethernet port," he said. "That cuts down on the individual cables."

Growing contractor opportunities

As interest in PoE lighting is beginning to take off, those in the field see growing opportunities for electrical contractors, though it can vary by region, Pospisal said.

"What we've seen, it depends what part of the country the project is occurring in. We've worked with a number of different contractors, from electrical contractors to integrators to low-voltage contractors," he said. "A lot of times these days, we see electrical contractors that have a low-voltage division and that works really well for us."

This corresponds to a trend noted in ELECTRICAL CONTRACTOR's "2020 Profile of the Electrical Contractor." There, 96% of respondents said their firms perform low-voltage work, while 22% reported their firms have a separate low-voltage division. That's double the figure from the 2018 survey.

Milton believes even more electrical contractors should be exploring low-voltage PoE opportunities.

"If the business is growing as fast as we see it—if it continues—I can see electrical contractors teaming up with, or even becoming, software installers, so that they're a turnkey solution, and I think that's going to be very healthy," he said.

In terms of the next five years or so, commercial office space and healthcare, with hotels coming up close behind, appear to be the markets most likely to grow the fastest.

"We're deploying in offices, in hotels, in schools—we're definitely seeing the ramp-up function occur," Cicero said.

Wedekind said she sees lighting as possibly just a beginning for PoE.

"Given the ubiquitous nature of lighting, it can become a base for data collection in smart buildings through a coupling of luminaires, controls and sensors in one piece of equipment," she said. "For example, noise sensors, coupled with people-counting sensors and lighting fixtures, can be a crucial element of alarm systems in public spaces."

Pospisal agrees that lighting could be just the beginning for PoE adoption, as more low-voltage equipment gets added to commercial buildings and homes.

"PoE lighting was really just the entry into the building," he said, adding that devices such as motorized shades are an example of the technology's possible expansion. "We're leveraging the power and data from the lighting, but a lot of these applications need less power than lighting."