

FROM THE CEILING TO THE CLOUD

Intelligent Lighting and the Internet of Things

How a new generation of LED lighting gives credence to the promise of smarter buildings, spaces and cities.



WHAT'S HAPPENING TO THE INTERNET? BILLIONS OF THINGS.

Since Tim Berners Lee democratized online access with the creation of the World Wide Web in 1991, the Internet has been all about connecting more and more computers, and later, smartphones and other Internet-enabled devices, into a global network — 10 billion in all, at last count.

Who would have guessed that was just a first step? Today, anything and everything is potentially a web-enabled device — from municipal trash cans that signal the sanitation department when they need emptying to tiny heart monitors that alert your smartphone of an arrhythmia.

Small, Internet-enabled digital sensors and controls can be embedded in virtually any machine, device or material object to take and respond to measurements, transmit data about their environment, and improve the efficiency and functionality of the physical objects they monitor.

This is the Internet of Things (IoT), and it's quickly rising in mainstream awareness as the next big thing. Big is the word — Gartner predicts as many as 25 billion IoT devices may be Internet-enabled by 2020.¹ Some estimates double that figure.

While IoT is still in its infancy, special IoT applications have been used for years. When an airbag is triggered by an automobile accident and your car sends an alert to OnStar®, that's the Internet of Things. Fitness trackers, remote baby monitors and automated toll roads are all IoT devices. Many industries already use IoT sensors to monitor vibration, temperature and other variables in machinery, and to transmit alerts to operators before components fail.

Now the bigger potential of IoT is being driven by a convergence of technology advances: the cloud, the embrace of big data and the increased expectations and technical savvy of a digital workforce. But what's needed is a unifying platform ready and able to quickly and efficiently connect new things to the Internet.

As it turns out, that platform already exists.

THE GROUNDWORK HAS BEEN LAID, RIGHT ABOVE OUR HEADS.

Since Cree commercialized the first commercially viable LED lighting fixtures in 2006, LED lighting has grown to become the default choice for new lighting and upgrades. McKinsey expects the value-based U.S. market share for LED lighting to reach 45% in 2016 and 70% by 2020² as the market moves rapidly toward 100% LED adoption. The reasons are many — better lighting quality, deeply lower energy costs and a much longer, low-maintenance life.

Now companies in both the LED and IT industries recognize that LED lighting is the perfect platform to turn the Internet of Things into a workday reality.

LED lighting will drive the widespread adoption of practical IoT for two reasons. First, it's ubiquitous. Wherever you find people, you'll find lighting. Second, every LED light is built on a digital platform with power and intelligence. Any number of sensors and wireless communication devices can piggyback on this digital framework, enabling microphones and cameras, temperature and humidity monitoring, RFID readers, device tracking, emergency alerting and more.

Several critical factors have now aligned to make this the ideal time for LED lighting to enable IoT for buildings:



FALLING PRICES, RISING PERFORMANCE

Component prices for LED lighting and fixtures are decreasing even as they gain greater efficiency and efficacy. Thanks to smartphones, there is now a variety of inexpensive, sophisticated sensors that can be adapted for light fixtures. Prices also continue to drop for Wi-fi, Bluetooth®, RFID and other wireless technologies.



LIGHTING UP THE CLOUD

Cloud computing is designed for big data storage, offers powerful software engines for analytical processing and is accessible by every web-enabled device — exactly what is required to analyze and act on the constant stream of data produced by intelligent lighting platforms.



POWER OVER ETHERNET

Power over Ethernet (PoE) uses standard Ethernet cables to carry both power and data, replacing more expensive AC wiring while networking LEDs and a complement of sensors. Instead of wiring the light fixture into the building's AC electrical system, it's simply plugged into an Ethernet port and the network.



HIGHER EXPECTATIONS

The workforce is increasingly populated by so-called "digital natives" who grew up with the Internet. They expect workplace technology to work like the best consumer apps for their phones and tablets: seamless, scalable, interoperable, with elegant and intuitive interfaces. They also expect their work environment to conform to their tasks and needs, not the other way around.



BIG DEMAND FOR BIG DATA

The 21-century enterprise uses data analytics to cut costs, gain efficiencies and automate processes. As companies grasp the potential savings and gains provided by intelligent lighting, they're pushing to do the same with data generated by their intelligent facilities to improve efficiency, predict demands, and optimize the productivity and work experience of end users.

Because of these developments, intelligent lighting is now poised to transform our building spaces, parking lots and the roadways that connect them into energy-efficient, adaptive environments that boost productivity, optimize utilization and interact with users.

FROM CONTROLLING COSTS TO CREATING POSSIBILITIES: CREE'S SMARTCAST® TECHNOLOGY SOLUTION.

Totaling 87 billion square feet of intensively utilized space, our nation's commercial buildings are leading candidates for intelligent lighting. Those not already using LED lighting will eventually upgrade to it. Energy is a large percentage of their operating costs. Productive, comfortable spaces are a necessity: as companies compete for knowledge workers, cubicles and walled offices are giving way to bright, open, flexible spaces that foster collaboration, integrate technology and cater to personal preferences.

Lighting typically accounts for more than a quarter of a commercial building's electricity use, or about 10% of the building's operating costs.³ But while lighting controls for occupancy sensing, scheduling and dimming have been around for decades and can offer energy savings as high as 66%,⁴ adoption in the U.S. market has been a negligible two percent.⁵ A 2015 U.S. Department of Energy report cites complexity, lack of standardization, and high costs among the chief barriers: control systems are proprietary and non-interoperable, costly, and difficult to install and reconfigure.⁶

In offering a solution to this low adoption of lighting controls, a 2015 DOE study offered an aspirational vision: that by 2020, a majority of luminaires might be "shipped from the factory with embedded sensors and intelligence" and "installation costs and complexity greatly reduced."

For Cree customers, 2020 arrived early. In 2014, Cree introduced SmartCast® Technology. Lighting sensors and intelligence are built into every SmartCast® Technology fixture. Exacting user-driven design and engineering allow "one-button" commissioning to enable a network of up to 250 lights at a time. SmartCast® Technology fixtures communicate wirelessly with each other to automatically create a lighting network and intelligently group lights together, eliminating the painstaking and error-prone process of manually commissioning each light. SmartCast® Technology provides greatly simplified daylight harvesting, motion sensing, adaptive lighting and dimming without third-party devices, additional wires or manual commissioning, for about 50% of the installed cost of other solutions.

While the original SmartCast lighting network is autonomous and self-contained, tying building systems together requires a unifying platform. But not just any platform: Cree realized that widespread adoption of IoT enablement would only happen if the platform was embraced. Taking the final step of connecting SmartCast to the Internet meant ensuring the "one-button" principle of intuitive and effortless installation and management could be applied to the more complex tasks of commissioning Internet-enabled fixtures into configurable networks.



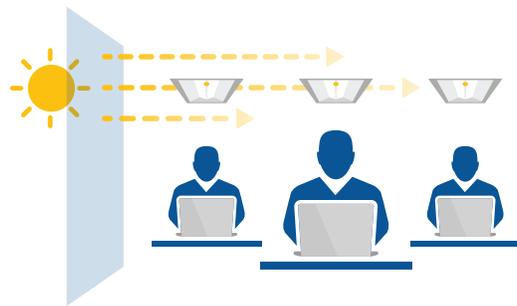
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BEYOND INTELLIGENT LIGHTING, INTELLIGENT EVERYTHING.

The original SmartCast® Technology addressed cost, simplicity and ease of use. But building owners, engineers and architects don't want to stop at lighting. Commercial buildings have a multiplicity of complex systems such as HVAC, plumbing, smoke and fire, security and safety that must respond to dynamic conditions, and all are candidates for greater efficiency, control and interaction to create cost savings and better experiences for the end user.

The next generation of SmartCast® Technology solutions are Internet-capable via Ethernet connectivity, yet customers may enjoy the compelling business case of energy savings and better light without it. The scalable intelligence of SmartCast® Technology starts with baseline strategies such as occupancy detection and daylight harvesting that are enabled with the push of a button and no connectivity.

With SmartCast® PoE, customers can employ “one button” building commissioning of up to 1,000 intelligence devices at one time, and the Smart-Cast® Manager Application will enable advanced energy-saving strategies like task tuning and real-time visibility into energy usage.



The scalability of SmartCast® PoE extends further when networked and connected to other devices. It will be able to monitor and adjust for occupancy patterns, resource utilization and much more. Ultimately, these customers will be able to apply the same kind of enterprise-wide asset management as with any IT device, to remotely monitor, update, track and configure every fixture, sensor and control on the lighting network.

It's no wonder Cisco has given the name “the digital ceiling” to their IoT/PoE initiative for smart buildings. The ceiling and plenum is where lighting lives, and it's where the IoT will come to life in facilities spanning commercial, educational, healthcare and municipal sectors.

WE CREATED BETTER LIGHT. NOW WE ARE CREATING BETTER WAYS TO USE IT.

Cree was founded on an audacious vision — the belief there was a better way to create light — and continues to lead the LED lighting industry with a continuous stream of breakthroughs and innovations.

At the heart of all these innovations is an ethos we call *Better Light*. *Better Light* is our vision for an informed and informative LED lighting platform enabling higher productivity, heightened sense of well-being, greater safety, security and comfort. It speaks to beautifully illuminated spaces wherever people work, live and gather and effortless automation of tasks and processes at work, at home and in public spaces.

***Better Light* is simply light that improves every aspect of life:**

- *When LED light fixtures are visually appealing; easy to design, install and operate; and provide intuitive functionality, that's **Better Light**.*
- *When LED lighting provides greater energy savings, scalability and flexibility, and connected and intelligent operation, that's **Better Light**.*
- *When LED lighting provides real-time data visibility and decision support for facilities, traffic control, safety and security, that's **Better Light**.*
- *When LED lighting allows increased end-user control and adaptation to individual preferences in lighting and environmental systems, that's **Better Light**.*
- *When fixture monitoring and maintenance, re-configuration, upgrades and expansion are all simplified, that's **Better Light**.*

ENABLING IOT FOR THE ENTERPRISE WITHOUT A TANGLED WEB.

Like any new technology or disruptive innovation, connected intelligent lighting comes with new concerns and potential issues, such as increased cost, complexity, interoperability and new demands on human attention — itself a scarce resource.

Cree is addressing these challenges with the same vision we applied to create LED lighting — novel approaches, relentless research and intensive engineering. The resulting SmartCast® Technology solutions:

- *Anticipate the challenges of embracing disruptive technologies*
- *Remove the burden of added complexity, expense and required attention*
- *Build the learning curve into the solution so people can learn as they use it*
- *Create “simplicity on the far side of complexity” — effortless usability and intuitive, simple and scalable functionality*

The next generation of Cree lighting won't just be about illumination any more than your smartphone is simply about making phone calls. While early cell phones only delivered voice communication, the Internet-enabled smartphone provides the framework for virtually limitless open-source and third-party apps and functionality.

We're working toward a similar goal with Cree SmartCast® Technology to develop a connected, sensor-rich platform that creates an ecosystem of open-source and third-party apps/sensors. Ultimately, Cree will enable an “app store for buildings” that could offer virtually any application imaginable, from intelligent sensors to optimize labor, space and energy resources, to video security, asset tracking and contextual marketing.

CREE: SEEING WHAT COULD BE.

“Is it a fact — or have I dreamt it — that, by means of electricity, the world of matter has become a great nerve, vibrating thousands of miles in a breathless point of time? Rather, the round globe is a vast head, a brain, instinct with intelligence!”

—The House of Seven Gables, Ch. 17., 1851

When U.S. novelist Nathaniel Hawthorne wrote those words 165 years ago, he was referring to the only practical application of electricity in his time — the telegraph. Yet by seeing what could be, he grasped the potential for a connected world with extraordinary vision.

By seeing what could be, Cree changed the world's very idea of lighting. As the platform for the Internet of Things, Cree® LED lighting will now transform how we work, live and play. This is our vision: Better Light for a better world, made intelligent in a breathless point of time.

¹ Gartner Says 4.9 Billion Connected “Things” Will Be in Use in 2015

² McKinsey & Company: *Lighting_the_way_Perspectives_on_global_lighting_market_2012*

³ Lawrence Berkley National Laboratory; July 2013

⁴ *ibid*

⁵ Commercial Advanced Lighting Control Demonstration and Deployment: 2015 Building Technologies Office Peer Review, US DOE

⁶ *Ibid*

Visit lighting.cree.com/smartcast or contact a Cree lighting representative to learn more.

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