Designing for a Brighter Tomorrow

Why Your Commercial Lighting Infrastructure Needs to be Smart and Connected

The History of Lighting

1780 | Oil lamp

1792 | Gas lamp

1874 | Incandescent light bulb

1926 | Fluorescent lamp

2010 | Household LED lamp

Lighting has always been an important part of our lives - from the invention of oil and gas lamps to incandescent bulbs, and in the recent years, LED-based lighting. As long as lights have existed and continue to exist, they serve us by bringing light to the darkness. But in the age of the IoT, our lighting infrastructure has an opportunity to become something more valuable, whether it's helping us conserve energy, collecting data about our environment, helping us use our space more efficiently, or even helping find the things we lose.

Energy Consumption in the Commercial Sector

One of the major drivers in the lighting industry over the past few years has been lowering energy bills and a smaller carbon footprint for lighting. If one looks at the main energy consumption in a commercial building, lighting can be up to 25 percent of the energy consumed, followed closely by cooling and heating. As the population keeps growing, so too does the demand for lighting, and the energy cost associated with this growth needs to be addressed.

In order to save energy and reduce the carbon footprint of lighting, one of the major recent trends in the industry has been to reduce the energy required for lighting. This has driven the fast adoption of LEDS in both commercial and residential use cases. LED lighting is estimated to save up to 25 percent more energy and the lifetime of LED lighting is expected to be 10-20 times longer than traditional solutions.

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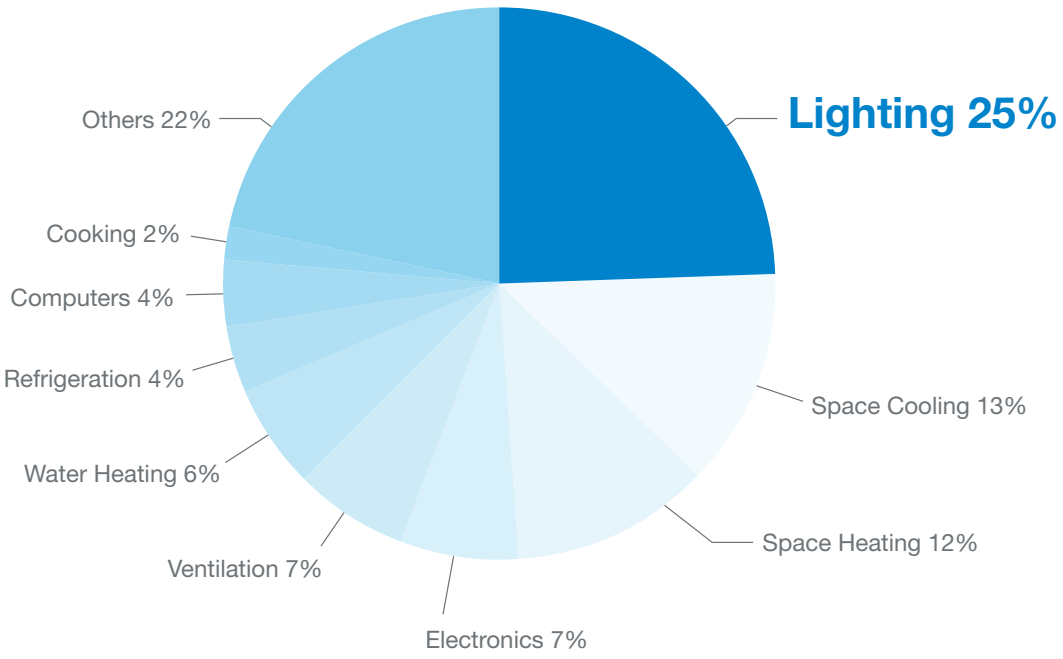
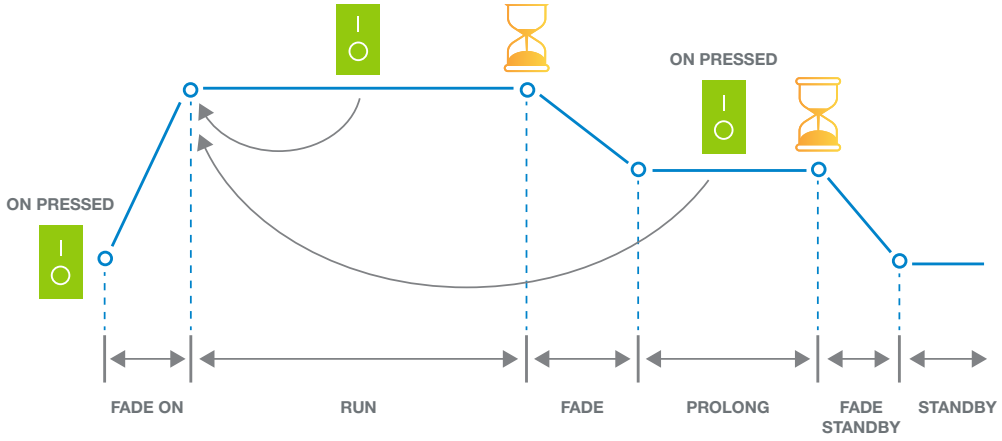


Source: **Lighting energy in buildings**

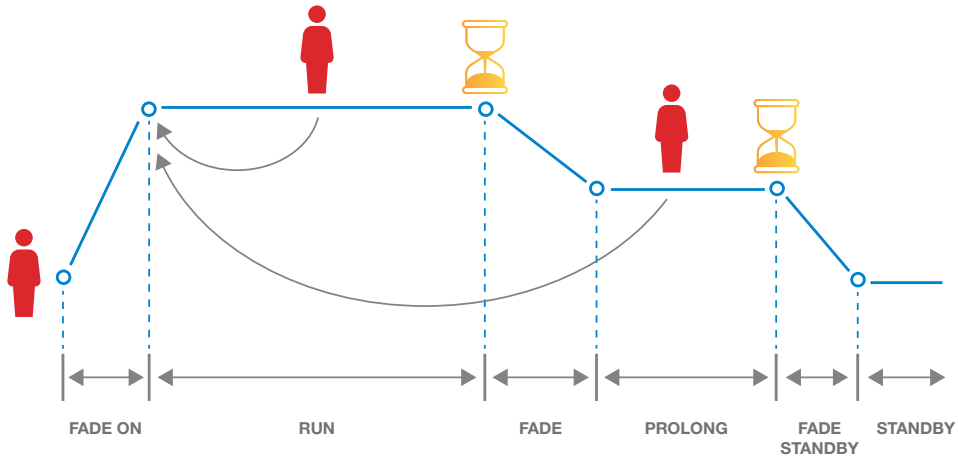
To further reduce energy consumption, sensors can be used in conjunction with smart lights. These sensors are typically occupancy sensors that detect the presence of people in spaces or daylighting sensors that detect the lux level in a certain area. The sensors then feed the data to the smart luminaires which autonomously control their on/off state or lumen output level. This can significantly reduce the energy consumption of lighting as the luminaires are only on when necessary and only driven at the needed lumen output given the amount of ambient light.

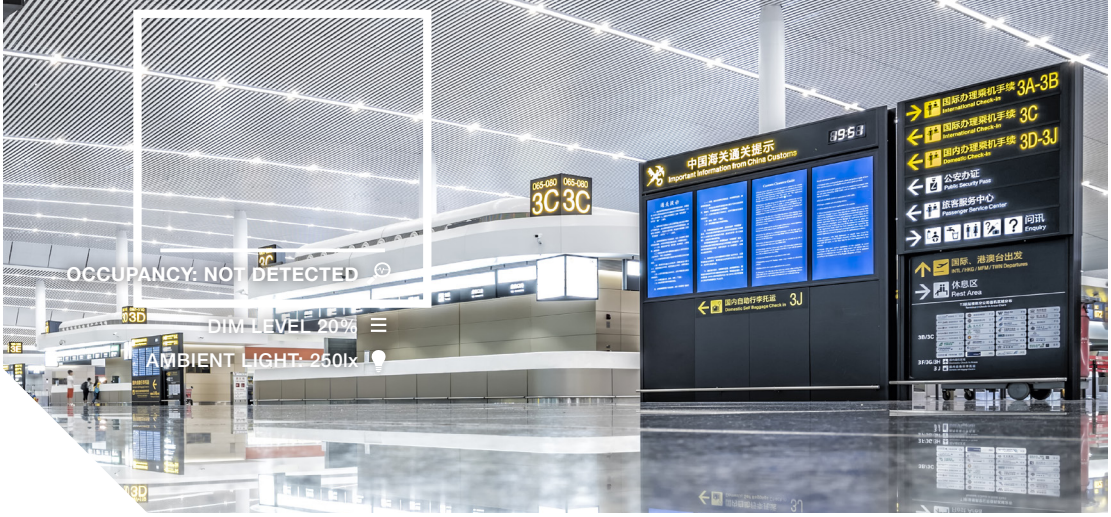
Regulation is also starting to be put in place, including **California's Title 24 Building Energy Efficiency Standard,** which for example requires the use of the above sensors in all new lighting installations. The part of the standard that relates to non-residential buildings mandates the use of lighting controls on a per-room basis, with separate controls for the type of lights used. More pertinently, the standard calls for systems that can automatically adjust and control lighting output based on occupancy and ambient/natural light.

Switch Based Automatic Lighting Control



Occupancy Based Automatic Lighting Control





While the addition of sensors as part of the lighting infrastructure can provide the benefits described above, it also makes the lighting infrastructure more complex. This especially impacts the installation and maintenance of the network. Installers aren't simply installing the devices, but they also have to group devices into logical sets and decide, for example, to which luminaires the sensors feed data to. The more complex the installation, the more resources are required and the costlier the solution.

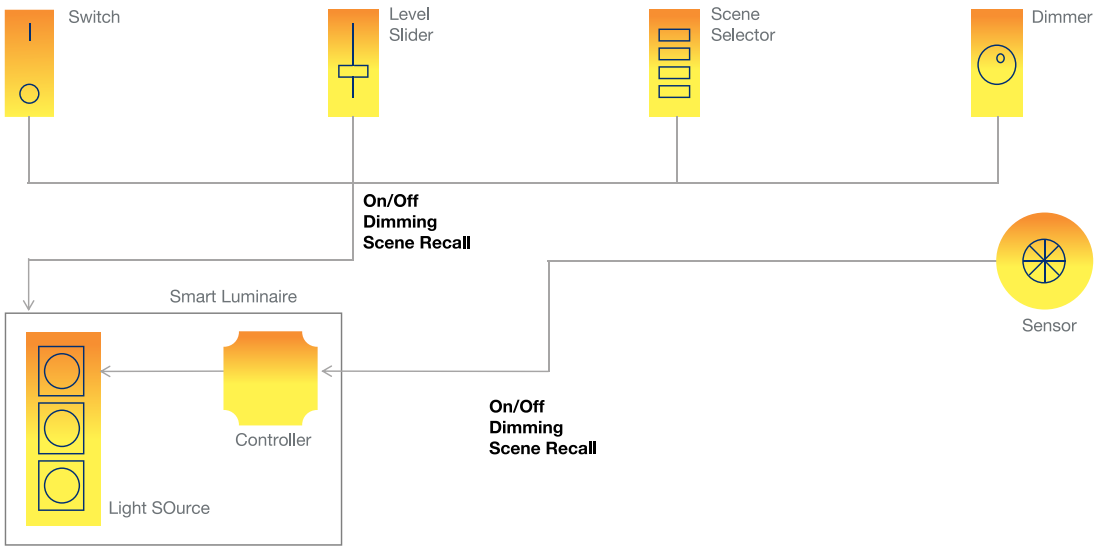


Figure 1: Basic smart lighting network

Another challenge that comes with added functionality is that it's difficult for one company to build all the components needed for a complete solution. Different companies have different competencies, and while one may be excellent at building luminaires others will be better at sensor development or all creating the software needed for commissioning and maintenance. Instead, an ecosystem of companies, each with their core competencies, should be able to accomplish more and be able to do it faster than individual companies alone in order to benefit everyone with a potential mainstream adoption of smart lighting solutions. For the industry to effectively work together and reduce duplicate work, common standards and interoperability is required that are public domain and available for everyone to use.

The Value-Add Opportunity for Wireless Lighting Control

As mentioned earlier, the lighting industry is in a unique position in the IoT industry as they have the most widespread infrastructure. After all, lighting is ubiquitous - from indoor locations including offices, retail, and airports, to stadiums and street lighting.

Most of lighting is also mains powered today, so they have the energy available to act as an access point and the infrastructure for the IoT end nodes. Using lighting as the infrastructure for the IoT end nodes can come at significantly lower costs than installing dedicated infrastructure for each use case.

The lighting industry has an opportunity to enable a lot of IoT applications and add value for themselves, whether it be collection and utilization of sensor data such as occupancy, temperature, humidity, and air quality data or location-based services like indoor wayfinding, panic and call buttons, and asset tracking.

40%

of connected end points in commercial buildings will be smart lighting based bt 2021

Source: ABI Research

Getting Smart About Luminaires

So how can the lighting industry contribute to reducing the carbon footprint and increase energy savings, as well as evolve to offer more advanced solutions than just lighting?

IoT is one solution and there are multiple examples in the marketplace showing how smart and connected products can disrupt dynamics. One example could be the shared scooter industry and companies like Lime, which basically went from zero to almost 50 percent market share in micro mobility. A lot of this was enabled by smart and connected IoT products.

So how can connectivity be used in lighting? The answer is that it's already used in a lot of lighting applications today. A large portion of commercial lighting uses wired protocols like DALI to interconnect controls, sensors, and luminaires for basic functionality like on/off and dimming. In the faster moving residential applications, wireless is gaining share as the communications interface to enable easy retrofits and the same on/off, sensor, and luminaire interconnectivity. But it can also add internet connectivity and additional services through hubs and gateways.

Innovative commercial lighting companies have started adopting wireless communication to replace existing wired installations because of the flexibility wireless connectivity offers. As mentioned, the introduction of occupancy and daylighting sensors can significantly reduce energy consumption and regulations are even starting to mandate them. Using wireless connectivity can simplify the sensor deployments through more flexible sensor placements, battery powered sensors, and easier reconfiguration of the networks versus using wired connectivity. Also, wireless technologies like Bluetooth enable the use of smart phone applications to automate the setup and configuration of networks.

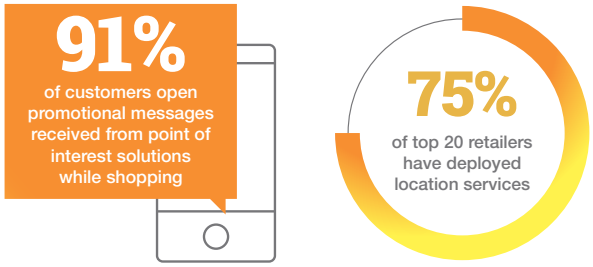
In Retail

When switching out their traditional overhead lights with LEDs, Target installed Bluetooth beacons in the fixtures to enable wayfinding solutions that help customers and employees navigate the store and find products faster and easier. Retailers around the globe are also leveraging Bluetooth beacons to broadcast personalized promotions that create better shopper experiences and increase sales.

> "The real power of adding wireless to lighting comes in the extra applications and use cases it enables. Lighting being everywhere in buildings makes it an ideal wireless infrastructure for IoT applications to leverage features including environmental sensing, occupancy and space utilization monitoring, or location-aware applications such as indoor positioning and asset tracking."

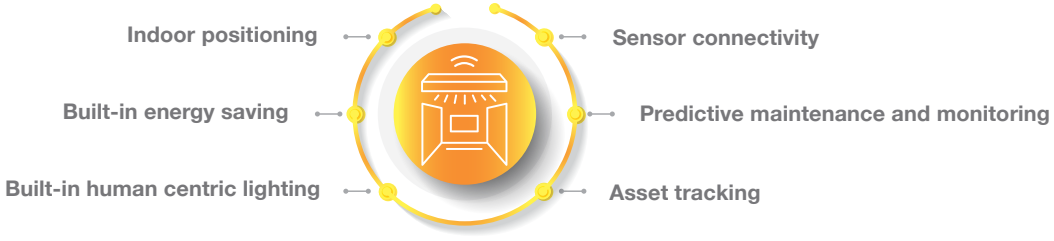
Source: Lighting as a platform

While replacing wires with wireless has some benefits for lighting, the real potential of wireless connectivity is the extra value-added services that can be enabled. Connectivity like Bluetooth enables interaction with smart phones, for example, for location-based services including wayfinding and asset tracking. Almost all phones today have Bluetooth, and turning the luminaires into a beacon infrastructure can be used to provide indoor positioning to phones which can be evolved to wayfinding and indoor mapping applications. Bluetooth technology also enables the manufacturing of low-cost and low-power Bluetooth tags which broadcast their position frequently while operating on coin cell batteries for up to 5-10 years. The luminaries could capture these tags and their location, and again enable a whole new level of services from Find-My type applications to social distancing and so on.



Source: Lighting as a platform

Connecting the luminaires could also provide the manufacturers valuable information about their operation for predictive maintenance and monitoring applications and enable rolling out new features through remote software updates.



2020
Smart and Connected Lighting

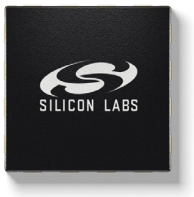
Lighting the Path Forward

What does Silicon Labs do to enable smart and connected Luminaires?

At Silicon Labs we enable wireless connectivity for the IoT applications, whether it's Bluetooth, Zigbee, 15.4 proprietary, or Wi-Fi protocols. We build wireless SoCs that integrate multiprotocol radios into ARM Cortex MCUs and necessary peripherals to drive LEDs, collect sensor data, or interface to other peripherals.

We also invest a lot into standard networking protocols including Bluetooth, Bluetooth mesh, Zigbee, Thread, and others because we believe standards are the way forward as they enable true interoperability between multiple vendors, evolve to meet the market needs, and reduce the needs of our customers to develop multiprotocol connectivity. Plus, standards let them focus on their own core competencies.

We've built radios and connectivity protocols for more than 20 years, and we lead the market with many of them. We're continuously innovating to increase the throughput and scale of the protocols, reduce power consumption and system cost, and bring new technologies to our customers that help them to evolve their business.



EFR32xG21 Wireless SoC for Lighting

Radio
Up to +20 dBm TX
Extremely good RX sensitivity
Bluetooth 5.1
IEEE802.15.4

Current Consumption
8.8 mA RX (1 Mbit/s GFSK)
9.3 mA TX @ 0 dBm
33.8 mA TX @ 10 dBm

World Class Protocol Stacks
Bluetooth 5.1 and Bluetooth mesh
Zigbee 3.0
Open Thread
Apple HomeKit

Compact Size
4x4 QFN32 (20 GPIO)

ARM Cortex-M33 with TrustZone
80 MHz w/FPU and DSP
Up to 92kB RAM and 1024kB flash
50.9 uA/MHz

Peripherals Fit for Purpose
3x USART, 2x 12C
1x12-bit ADC, 2x ACMP
7x timers
Up to 20x GPIO

Security
True Random Number Generator
Hardware Accelerated Crypto Engine
Secure Boot with RTLS
Secure debug with lock/unlock
DPA Countermeasures

With Secure Vault
Anti Tamper
Secure attestation
Secure Key management and storage
Advanced crypto

Mikko Savolainen is a Senior Product Manager at Silicon Labs, where he is responsible for the marketing of Silicon Labs' commercial lighting, indoor positioning, asset tracking and clinical medical solutions. Mikko joined Silicon Labs in February 2015 after the company's acquisition of Bluegiga Technologies.

Interested in learning how Silicon Labs' commercial lighting solutions can help your business?

Contact us today.

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