ZigBee for Wireless Lighting Control

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Advances in color LED technology and wireless networking are enabling new possibilities for lighting control by making it easier and more cost effective to retrofit modern illumination systems while also making the lighting system's controllers more convenient to use from anywhere in or around the building. Until now this market has been served by a range of solutions each with its own particular strengths and weaknesses. One problem is that consumers have no simple way to ensure products from different manufacturers will work together which makes it extremely difficult to extend a home lighting system. Additionally, some complex commissioning processes required for such networks often means that users struggle to add new devices, even with products from the same manufacturer.

By defining a common standard available to all product designers, the new lighting profile from the ZigBee Alliance addresses both of these issues. Developed along with major global lighting manufacturers, the ZigBee Light Link (ZLL) profile not only describes an application messaging protocol for advanced lighting control, but it also includes a mechanism which makes out-of-the-box commissioning simple. ZLL also leverages standard ZigBee profile characteristics – robust and secure mesh networks based on low-power, low-cost IEEE 802.15.4 radio technology.

Simple device commissioning

As with any new consumer technology, complexity can be a significant barrier to growth. A key principle during the development of the ZLL profile was that the operation of the system be highly intuitive, and certainly no more complex than a traditional wired lighting system.

Advanced lighting control features

Unlike other ZigBee profiles such as Home Automation (HA), ZLL was designed 100 percent for lighting applications. This allows ZLL products to easily implement different color settings, dimming levels and brightness, store atmosphere settings or automate lighting control for maximum convenience and energy efficiency. The extent to which these features are implemented is a choice entirely for the product designer and systems can be as simple as a single on/off light and switch, or as complex as a fully featured home lighting solution.

These features are all based on the ZigBee cluster library concept which provides a suite of application level over-the-air messaging protocols. ZLL incorporates and extends those clusters most appropriate to home lighting applications and uses these to define a range of standard devices on which designers can base real-world products.

Assured interoperability

Since the entire system is based on open standards, product designers and consumers can be confident that certified ZigBee Light Link devices will all work together seamlessly. The first step to ensuring device interoperability is using a ZigBee-compliant platform which ensures easy certification through the ZigBee Alliance. The next stage is to ensure the application level features are compliant with the ZLL specification. The last step is to configure the code to interact with the specific product hardware – for example physically turning the light on and off when the appropriate message is received.

One extra benefit of using the ZigBee standard is that ZLL devices are also interoperable on the network level with devices based on other application profiles, such as HA. This allows the end users to integrate different devices in the home, providing a larger and more robust wireless infrastructure within the Connected Home

Under the hood

From a hardware perspective, competition in the chip vendor market has led to the availability of low-cost silicon ideally suited to the demands of lighting control applications. Low sleep current is one key parameter for battery driven devices, but features such as on-chip RF power amplifiers and advanced 32-bit CPUs also mean that cost-effective system-on-chip solutions are now available to the mass market. Because the standard is based on the globally available 2.4GHz ISM band, manufacturers are able to offer ZLL products to a global market.

The existing ZigBee PRO networking standard also offers several key benefits to wireless lighting control applications. The existing AES encryption mechanisms designed for M2M applications are well suited to consumer lighting, as they provide protection against both neighboring network traffic and malicious intrusion without impacting the end user experience. Also, since the mesh network is scalable to thousands of nodes, there is almost limitless scope to extend the solution to incorporate a large number of lights, controllers and sensors into a single integrated system that greatly enhances comfort, convenience and energy efficiency to the consumer.

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