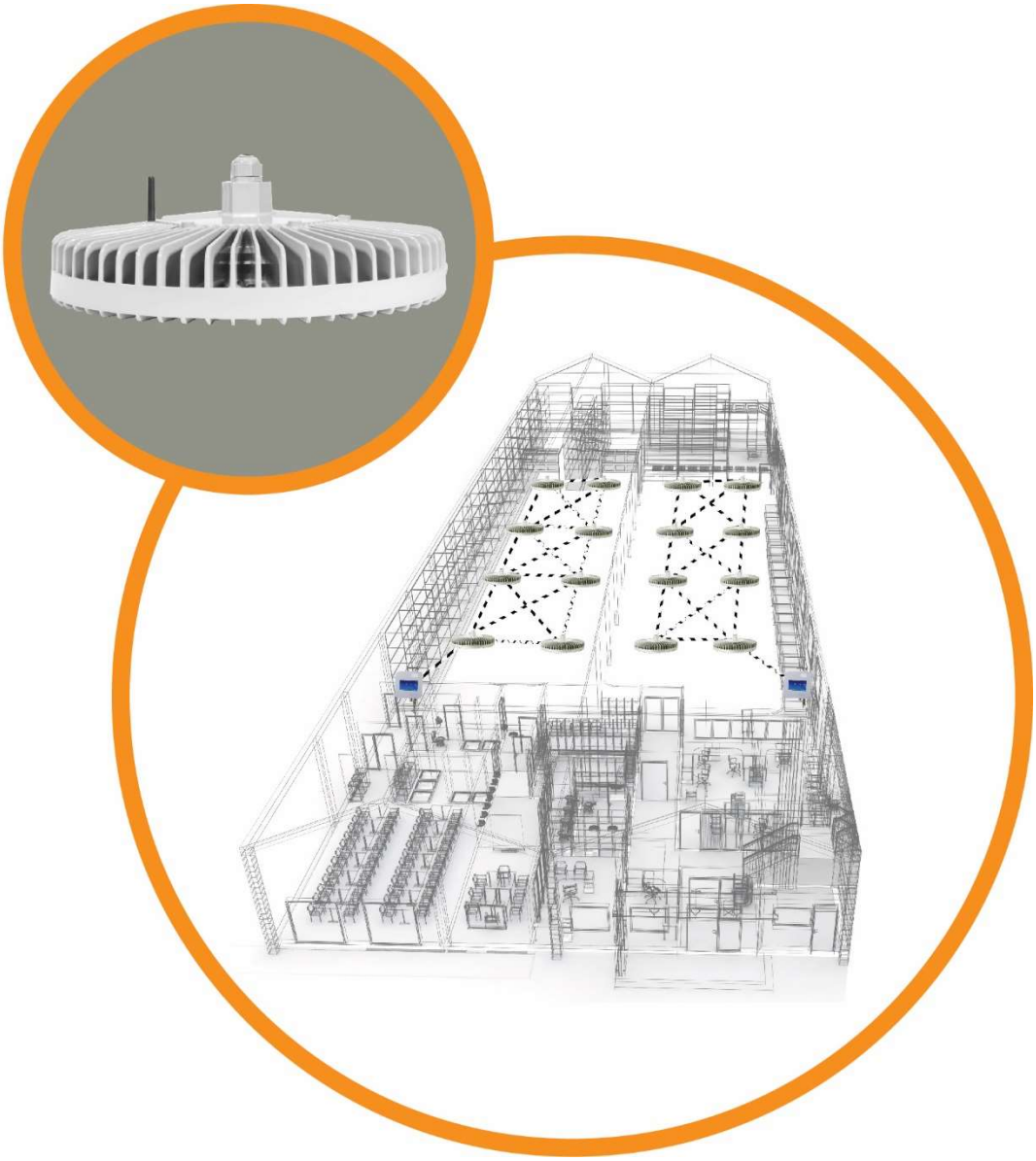
Industrial LED Lighting Network as Wireless Access Infrastructure



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On When it Counts.

Smart LEDs and Lighting Control

The benefits of upgrading to LED lighting for light and heavy industrial sites are well documented. In addition to measurable savings in energy and associated costs, reduced down time and maintenance costs contribute to measurable gains. Other benefits include improved safety, increased productivity due to better quality of light and improved mood and morale, improved quality check and improved health and wellness of employees.

These gains are realized only with a well-behaved lighting fabric, which means a properly designed lighting control should be included with the upgraded LED lights. Such lighting control systems enable dimming of individual or groups of luminaires based on pre-defined schedules, time of day, or occupancy of certain areas.

Sophisticated industrial users of lighting systems take the next logical step and integrate the lighting controls with smart manufacturing and industrial or process controls to realize even greater gains from **condition-based lighting control**. Examples include scenarios where rich environmental data, such as presence of people and assets in various locations and machine state data, could be fused to render fine grained control decisions regarding the operation of the lighting and the machines.

Consider the safety and convenience of a lighting system that indicates, by flashing a subset of luminaires, the exact location of a malfunctioning piece of equipment, or lights that autonomously turn to 100% intensity upon detecting an accident on the factory floor or processing plant. Dialight has control-enabled lighting systems with built-in interfaces allowing easy integration to most major industrial controllers or building management systems which enable the lighting to be an integral part of the factory's control.

Typical Networked Lighting Systems include:

- LED Luminaires
- Occupancy Sensors
- Daylight Harvesting Sensors
- Wireless Controllers
- Control System with Connectivity to Industrial PLCs
- Additional Sensors

IoT, IIoT and the need for a Well-connected Factory

Internet of Things (IoT) is a group of enabling technologies that support remote monitoring and actuation of smart connected "things". Industrial Internet of Things (IIoT) is a grouping of technologies enabling the same for "industrial things" such as pumps, valves, motors, sensors, and, in Dialight's case, lights using industrial protocols in use cases related to industrial applications such as discreet manufacturing and process control. At the heart of this vision are

the innumerable sensors, machines and other data collecting points that provide and consume information across the industrial site.

Smart Manufacturing, enabled by a well-connected enterprise and IIoT technologies, bring together machinery, process systems, sensors and hand held devices in a modern automation system and provide increased visibility of operations to help people and machines work smarter together.

In general, given the prevalence of existing smart connected devices in industrial settings (albeit in some cases using proprietary and closed systems), Industrial Internet of Things use cases are typically at the vanguard of the IoT and present the most concrete ROI computations.

One of the major benefits of the IIoT is realized when previously stranded data from smart sensors, equipment, and other industrial assets is connected to decision making and analytical engines running in situ at the edge in the plant/factory or in the cloud.

In fact, a variety of non-real-time and non-control applications are increasingly finding traction within the IIoT domain as the earliest wave of productivity applications. For example, using historical and multi-modal machine state data, it is possible to schedule condition-based maintenance sessions for equipment, minimizing the rate of occurrence of costly unexpected failures and emergency repair sessions.

A documented use case of just-in-time maintenance and how it realized savings is related to monitoring of steam traps at a chemical company in Singapore [1]. Stream is a major and important source of energy in industry. Failed steam traps allow steam to escape from its intended route resulting in wasted energy, lower efficiency and higher operating costs. Inspection of these traps, when performed manually, is time consuming and labor intensive and, as such, would be performed once every 52 weeks. Upon installation of wireless steam trap sensors, the steam traps were automatically inspected and results were audited and tabulated once every week. As a result, the total rate of incidence of failed steam traps went down from 22% to 10% over the course of three months which yielded an overall savings of 7% in steam usage throughout the plant. In this particular use case, a dedicated wireless network, native to the sensors, was also installed allowing capture and transmission of sensor data to a central location for processing.

As seen above, a well-connected plant is critical. Providing the physical means of connectivity, be it wireless access, wired connection or a combination, as well as application level integration are required for successful outcomes.

The case where the Lighting System is more than just lights

Devices, people and machinery in industrial settings may be connected over wired or wireless infrastructure. Wired connectivity in industrial retrofit situations proves to be costly and inflexible. As a result, wireless connectivity is typically preferred.

Given the upward trend for adoption of LED lighting in industrial settings, it is not surprising that many sophisticated industrial end users are facing the dual tasks of upgrading lighting infrastructure as well as bringing wireless access to their industrial/hazardous operation sites. The problem of instrumenting a wireless infrastructure or lighting system in industrial and hazardous locations is not trivial. Such systems must mitigate a variety of challenges that are not encountered in typical commercial or office installations. These include:

- **Challenging RF**: presence of multiple obstructions, bulky equipment, metal structures, impact propagation conditions for RF signals
- **Large Areas**: covering large, cavernous areas, indoors or large distances outdoors.
- **Remote and Inaccessible Sites**: operating in remote areas with difficult access requires maintenance free products
- **Harsh Operating Environments**: dirty, extreme temperatures, hazardous chemicals, vapor, vibration and corrosion which are present in most industrial operation sites
- **High Rates of Network Availability and Reliability**: mission critical operations ongoing all day, every day with months or years in between scheduled down time
- **Stringent Quality of Service (QoS)**: for a subset of applications, near real time latency is required regardless of network congestion.
- **Autonomous Self Recovery**: remote access and high availability require the network to have robust, self-recovery mechanisms to identify and manage faults.
- **Security:** in critical infrastructure, lighting is a major security and safety component of plant operation. Securing its operation is important.
- **Lack of Existing Infrastructure**: in some sites, no backhaul or Ethernet fabric is present.

It is clear that the above requirements are the same for both lighting networks and industrial wireless access networks. Dialight has already solved virtually all of these in their current networked lighting system making it a viable foundation for wireless access upgrades in industrial settings.

Moving Forward

LED lighting is fast becoming the industry standard as is the need for wireless access in most industrial and hazardous sites. Given that Dialight's light fixtures are industrial rated, advantageously located and need to solve most of the same problems facing a typical wireless access network, it is a logical step to use the lighting network as the foundation for wireless access. While bandwidth and throughput speed need to be optimized to meet a particular user's requirements, the use of the lighting fixture's real estate and networking capability is a robust and cost effective solution for industrial applications.

References

[1] https://industrial-iot.com/2016/06/sounding-iiot-application-asia/