WIRELESS, Wired Lighting Controls or Both???
Abstract

- Advanced Lighting Controls utilize various strategies and GUI based controls to achieve energy savings while ensuring comfortable & safe work environment for building occupants. These intelligent controls can be deployed via “Wired”, “Wireless” or “Hybrid” methods. Deployment methods are typically influenced by building type, labor costs, ROI considerations, etc.
Objectives

• Justify the importance of “Intelligent lighting controls”;
• Define “Wired”, “Wireless” and “Hybrid” Lighting Controls;
• Identify the “cons” and “pros” associated with wired/wireless implementations;
• Evaluate the technologies & strategies that drive different implementations;
• Analyze system architectures that implement wired, wireless or hybrid type of lighting controls
Advanced Lighting Controls

DEFINITION & BENEFITS
Adv. Lighting Controls: Defined

- Allow modification of light levels depending on specific tasks, individual preferences, through hand-held device/s or computer

- Provide addressable control of each light fixture controlled through front end software
  - Embedded (software/hardware architectures) systems enable individual fixture controllability by assigning it with a unique address.

- Permit automatic switch on, off or dim capabilities based on photo/occupancy sensor inputs or time schedule

- Optimize energy consumption by self-monitoring room occupancy and adjusting light to suit occupancy status
  - With virtually accurate information about occupancy status in a building, lighting control can provide valuable information for integration with BMS systems, and further enhance the functionality of the BMS systems.

- Perform load shedding to reduce demand charges or overall building consumption in response to energy price spikes
Adv. Lighting Controls: Benefits

- Improve the return on investment (ROI)
- Energy savings
- Code compliance
- Sustainable building practices
- Convenience to building managers, as well as occupants
- Safety and security for occupants and visitors
- More flexibility in controlling lighting throughout the space
Advanced Lighting Controls

MAJOR CHARACTERISTICS
Energy Management Strategies

- Occupancy Control
- Smart Time Scheduling
- Task Tuning
- Variable Load Shedding
- Personal Control
- Daylight Harvesting
• An example illustrating the Graphical User Interface (GUI) for an “Addressable Lighting Control System”.

Each device on the floor plan has a unique address.
• Energy reporting, Scheduling events, Create/change events, BAS (BACnet) integration, etc.
A smart building is an intelligent space that optimizes efficiency, comfort, safety and asset performance within the building.

Coordinating the performance of multiple BASs not only save energy, but also maintain comfort in a way that optimizing each system separately could not.

The evolution of Internet of Things (IoT) and its ability to connect devices to the cloud is expected to lower the cost of instrument building with sensors.
- IoT offers cloud-based data analytics.

Source: IBM Corporation
Wired, Wireless & Hybrid Systems

TECHNOLOGY & ARCHITECTURE
Wired Addressable Systems

Low voltage digital

- Sometimes referred to as 4-wire dimming - uses two low-voltage, polarity-sensitive conductors to provide a dimming signal, while power is supplied separately to ensure proper operation of the driver.
  - It is emerging as the default dimming option with commercial LED fixtures. One reason for its rise to popularity was its documented open standards and consistent performance.

- Requires interface device to ballast/driver for addressability

- Networked via low voltage field bus

DALI

- Open protocol or systems with proprietary extensions to DALI

- Addressability built in ballasts/drivers

- Communication & power in one cable
In a typical hardwired lighting control system, control signals are sent using communication wires.
Wireless Addressable Systems

Low voltage digital

- Open protocol (ZigBee®, Wi-Fi® or proprietary
  - ZigBee features low power consumption (& extended battery life), mesh topology, self-configuring (discovery), self-healing (automatic redirection of communication in the event of unexpected interruptions in the network) and high level security (128-bit encryption)

- An interface device to ballast/driver is used for enabling wireless communication
ZigBee®

- ZigBee features low power consumption (extended battery life), mesh topology, self-configuring (discovery), self-healing (automatic redirection of communication in the event of unexpected interruptions in the network) and high level security (128-bit encryption)
- Requires interface device to ballast/driver for wireless communication
• Requires interface device to ballast/driver for wireless communication
• Basically replaces a cabled Ethernet connection with a wireless device.
– Essentially a proprietary protocol
– Based on point to point network topology
– The main objective of this technology is to allow sensors and switches to operate without batteries
In a wireless system, control devices communicate through the air using radio-frequency RF waves without the need for control wiring.
Combination of Wired/Wireless Addressable Systems

- Single server connects to both wired & wireless controllers
  - Wireless lighting control is used as an extension of wired lighting control network
    » One side of the building is wired while the other side of the building is wireless
Hybrid system is bets of both worlds – Combination of wired & wireless architectures
Hybrid Architecture - 2

Combination of Wired/Wireless Addressable Systems

- Enabling wired devices such as wallstations & sensors via wireless modules – in this scenario, low-voltage wired devices are connected to line voltage powered wireless modules.
  - Best of both worlds – no need to go back to ceiling.
  - No need to worry about battery replacement
  - Wireless modules and connected wired devices (sensors & wallstations) are all still individually addressable
Hybrid system is best of both worlds – Combination of wired & wireless architectures
Pros & Cons of Wired, Wireless Systems

COMPARING WIRED & WIRELESS
Wired System: Pros & Cons

Pros

- Control: Control over network traffic usage; users
- Security: No unauthorized network access
- Reliability: Always available, not affected by signal loss, etc.
- Speed: Network speed (for example, ZigBee speed = 250 kbits/sec, DALI speed = 1200 bits/sec, Ethernet speed = 10/100 Mbits/sec)

Cons

- Convenience: Require physical connections
- Cost: Hardware, cabling & installation costs
- Interruption of building operation: Lost productivity due to system installation
Wireless System: Pros & Cons

Pros

- Convenience – significant reduction in installation complexity
- Cost
- Reduced space, weight, and power requirements
- Easy to expand to accommodate changes and additions
- Ideal for hard-to-reach places
- Less or no interruption of building operation

Cons

- Control: Software-based system with features like web access, GUI-based control, and 3D display can overcome this issue
- Security: Wireless systems that employ 128-bit encryption can overcome this issue
- Reliability: Wireless systems that employ mesh topology, self-configuring, and self-healing features can overcome this issue
- Speed: Supports up to 250 kb/s (sufficient for control applications)
Verdict

WINNER?
Building Status

• Is your building already built or in the process of being built?
  – If the building is currently in the construction phase or under development, it is the most opportune time to integrate a wired lighting control system.
  – For a pre-existing building, a wireless lighting control solution will probably be your best option.
• Although wireless technology has come a long way, a wired solution is still the most reliable.
  – System can be configured to turn the lights to full brightness when loss of network/control connection is detected. This ensures building occupant safety is not compromised.
A Wireless system creates a mesh network: that is, more nodes/repeaters you have in a given radius the stronger the signal will be.

- Wired systems support long cable runs (for example, 2500 ft.)
Scalability

- Expanding on a wired centralized lighting system can be very difficult and costly
Budget Constraints

- Equipment & labor costs are generally higher for wired systems.
Verdict

Wired lighting system

• Before construction, more costly, and more secure.

Wireless lighting system

• After construction, cost effective and easier expandability.

Pick a system that utilizes “open/industry standard” protocol and at the same time offer wired, wireless & hybrid solutions/architectures
Thank you