

Designers Lighting Forum

Outdoor Lighting Controls, how technology is lowering costs and improving safety

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Course Description

Line voltage controls have been used to provide on/off control of individual fixtures or banks of fixtures. Today, the advancements in low voltage, wireless, and network lighting controls have created an opportunity to decrease operational costs through scheduling, dimming, and remote troubleshooting. In addition to reducing operational costs and improving ROI, these new features can increase the safety of maintenance staff and reduce administrative costs.





Learning Objectives

At the end of this course, participants will be able to:

- 1. Evaluate Lighting Controls prior to the L.E.D. Revolution
- 2. Recognize how technology can improve lighting controls
- 3. Describe the technology that is changing outdoor lighting controls
- 4. Summarize additional benefits of network lighting controls
- 5. Differentiate prescriptive and performance methodologies of specification and select the right platform for your application



Outdoor Lighting Controls

WISDOM FROM OUR CHILDHOOD

Nothing good happens after ...







Evaluate Lighting Controls prior to the L.E.D. Revolution



Pre-L.E.D. Lighting Controls

Start with an age test

- The hum of the fixture signaled it was time to go home
- Simplicity
- Binary On/Off
- No feedback in the event of failure





Pre-L.E.D. Lighting

- Highly inefficient
- High Energy consumption
- Significant lumen depreciation
- Maintenance







LED Lighting

- Higher Efficacy
- Lower Energy consumption
- Improved lumen maintenance
- Dimmable
- Easier to integrate to controls, diagnostics, etc



Energy Savings is no longer in the fixture retrofit





- Early LED conversions produced large reductions in wattage
 - 400W metal halide to around 275W LED
 - 250W metal halide to around 180W LED
- Today LED to LED conversions
 - 275W LED to 196W
 - 180W LED to 127W



Cabinet Photocell Control





Cabinet Photocell Control

No Power at Fixtures









Recognize how technology can improve lighting controls















LED Lighting and Dimming

- Most LED fixtures are dimmable and use an analog signal of 0 10V
- Drivers all have different ranges for dimming 1%-100%, 10%-100%. Indoor generally uses .1%, .5%, 1%, and occasionally 10%. Outdoor generally uses 10% as a low-end range.
- O Volts represents off or lowest output, 10 Volts represents on at the highest setting *

A. Linear

50%

Dimmer position

75%

100%

25%

55%

B. Logarithmic

75%

100%

on.org

50%

Dimmer position

25%

55%

 For these reasons and many others, two equivalent drivers can both be at 5V and not be at the same light level

* An FAO (Field Adjustable Output) may establish a lower full output setting than 100% 💈

Oversizing fixtures and dimming for expected performance

- Utilities typically rate lighting on power consumption (watts)
- Many utilities require fixtures to be "limited" in output to match rates
- Minimizing the output can be done through an adjustable output potentiometer or digital settings (Typical: 0-10V adjustment)





Why is this Important?

- Photocells are a fraction of the cost of light fixtures
- Their exposure to line voltage requires them to have surge protection
- AC (Alternating Current) switching relays are the second most common failure in photocells
- Consistency in dimming and control methods reduces consumer complaints
- Consumer complaints lead to.....

Truck rolls



Truck Rolls & Cost

- Do more with less
- Many Utilities use ultra conservative costs relating to truck rolls and those figures average between \$250-500 (<u>https://www.sandc.com/en/gridtalk/2017/march/20/the-real-cost-of-a-truck-roll</u>)
- In addition to the truck roll, understanding what components or materials are needed could result in multiple trips or trucks being sent to a site



Pain Points



Up to 40% of a muni's energy spending is on public lighting







Non-functional lighting creates public safety issues and lowers home valuations



Lighting is Critical for Safe Streets



Optimized Visibility

Makes it easier for drivers to see other road users, improving reaction time and reducing the risk of accidents.



Improved Reliability

Real-time outage alerts help cities repair streetlights faster.



Reduced Glare

Minimizes the impact of glare from fog, rain, and snow.



Depth Perception

Non-uniform lighting creates an additional dynamic that aids distance perception.



Underserved Users

Benefit the most from increased safety measures like street lighting.

Sustainable

Reduced energy consumption and greenhouse gas emissions



Strong ROI

Reinvest in additional improvement projects after the payback period of 3-4 years.



Less Crime

Better lighting reduces crime rates and facilitates more effective police engagements.

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Lighting is Critical for Safe Streets

9% increase in fatalities

since 2020 among all road users

43,000 people died

on US roads in 2022

National Highway Traffic Safety Administration (NHTSA)

2x more likely

for black people to be killed by drivers while walking

Smart Growth America

National Safety Council (NSC)

3x more likely

for people in low-income communities to be killed by drivers than people in highincome areas

Smart Growth America

45% increase

in pedestrian deaths from 2010 to 2019

Governors Highway Safety Association (GHSA)

50% reduction

Fatal and serious midblock crashes at night expected for each .05 cd/m₂ increase in average luminance

IATSS







Describe the technology that is changing outdoor lighting controls



ESG - Environmental, Social, and Governance

• 5 Primary Factors:

- Regulations: increased ESG regulation strengthens and speeds up the implementation of companies' ESG strategies.
- Strategic planning: city governments formulate strategic and overarching master plans for the city, following national objectives and directives.
- Funding and financing: the efficient allocation of financial resources is a key step in an ESG-based approach since it promotes sustainable economic growth and addresses important urban issues.
- Service provision: regional, local and city governments often set the rules for service providers in sectors responsible for emissions.
- Monitoring: city governments have the power to monitor local service delivery, and to make sure that
 regulatory compliance is present.

 Cities "on the rise" (Major industry, business, and state & local regulations pushing for sustainability





The Effect of Dimming

- Perceived light is higher than measured
 - 90% Measured = 95% Perceived
 - 30% Measured = 55% Perceived
- Dimming creates an energy savings, generally between 0.5-0.9 to 1
 - Example 10% dim (90% Measured) about 9% wattage saved
- Dimming extends lamp life





*Product specification subject to change

Why DALI?

- DALI is a platform that takes care of the control and power requirements of intelligent fixtures.
- It enables communication between drivers, sensors, and a wide array of devices to enable high performance
- A communications platform that provides a wide range of data including energy usage and diagnostics data in a standardized format
- Provides the ability to perform monitoring, predictive maintenance, asset management, and other tasks









DALI enables Low Voltage Devices

- Photocells can be low voltage to eliminate the common redundancy and failure points.
- Fixtures already have surge suppression
- New devices can communicate digitally
- Enables embedded devices
 - Use of flying leads
 - Better gasketing, ensures weathertight seal
- Zhaga receptacles



DALI - Data

- DALI enables data to be collected in a standardized format for use amongst other DALI devices
- Part 251 Luminaire Data (Memory Bank 1)
 - Luminaire information encoded into the driver by the luminaire manufacturer. Includes: voltage, light output, CCT, distribution, etc.
- Part 252 Energy Data
 - Provides information on the energy data reported by an LED driver including active energy or power, apparent energy or power, and load side energy or power
- Part 253 Diagnostics & Maintenance Data
 - Data related to the light source, driver, light engine, etc. for the purposes of asset tracking and performance monitoring



Bluetooth Connectivity

- New Controls have become available that provide the benefits of scheduled systems without a continuously connected network
- BLE (Bluetooth Low Energy) enables connectivity between your mobile device and outdoor assets
- Requires users to be within 100' range
- Enables bi-directional communication for uploading new profiles and downloading telemetry data





Bluetooth Connectivity

- Telemetry data can be used for first level troubleshooting. No need to use a lift to examine the fixtures.
- Remotely command fixtures on/off
- Enable Asset management through software CRM
- Lifecycle management features are enabled for installation, commissioning, and decommissioning
- O&M Update luminaire telemetry for web portal viewing or update profiles of the fixture to change scheduling, light output, etc.





Asset Management

- Eliminate the use of paper to track devices
- Customize fields to reflect the data that is important to your organization
- Pre-populate fields that are standard and enable manual entry for fields that or entries that are custom
- Track everything from pole type & height to lumen output and manufacturer



| Brand Hardware Variant | Firmware Version |
|---------------------------|------------------------------------|
| Hardware Variant | Operating Time |
| Operated Minute Research | Operating rime |
| SenarNumber | Lamp Burning Hours |
| MAC ID | Median Luminaire Life |
| Manufactured On | Start Counter |
| | Temperature |
| | Thermal Events Counter |
| | Lamp Failure |
| | Lamp Failure Counter |
| | Lamp Open Circuit |
| ature | Lamp Open Circuit Counter |
| | Lamp Short Circuit |
| | Lamp Short Circuit Counter |
| | Lamp Thermal Shutdown |
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| a | MAC UD Manufactured On iture |



Network Lighting Controls

- Enable connectivity without being in the field, remote access
- Revenue grade metering
- Troubleshooting
- Alarm management
- Analytics
- Data History
- Command and Control Lighting
- Asset and Inventory Management
- Smart City Device Support









Summarize additional benefits of network lighting controls





Network Lighting Controls



- Easy to implement through embedded controls or twist lock node for new and retrofit fixtures
- Communication backbone provides connection to cloud server where users can interact with the system. The most common are Mesh and LTE (Cellular)



Network Lighting Controls – Real Time Control

- Real time command and control of installed devices
- Troubleshooting
- Data Validation
- Streamline field operations
- Eliminate paper through digital records



Network Lighting Controls – Failure Detection/Alerts

- Deploy resources in a timelier fashion or optimize routes
- Diagnose issues prior to showing up onsite
- Get fixture specifics like pole height, fixture type/brand, and other information
- Automate alerts based upon scenarios (Example: 3 days without turning on, notify maintenance to service the fixture)







Network Lighting Controls – Life Cycle Management

- Helps cities and utilities complete deployments faster
- Perform maintenance, diagnostics, and control without being at the fixture
- Keep accurate information on fixtures and controls like:
 - GIS data
 - Wattage
 - Brand
 - Pole Height
 - Etc.





Smart City Device Support



Pole Tilt

| AIR QUALITY INDEX | | | | | | |
|-------------------|--------------------|--|----------------------|------------------------------|--|--|
| 0-50 GOOD | 51-100 MODERATE | 101-150 UNHEALTHY FOR SENSITIVE GROUPS | 151-200 UNHEALTHY | 201-300 VERY UNHEALTHY | | |
| Coles and | | | | | | |

Air Quality



Traffic Counting



EV Charging



Ambient Noise



Energized Pole





Differentiate prescriptive and performance methodologies of specification and select the right platform for your application



Documentation

Prescriptive Specifications

Conveys the requirements of a project through a detailed explanation of the components, where they should be installed, and how they should be interconnected. Performance Specifications

Outcome based specification intended to offer the manufacturer the ability to quote the appropriate components to deliver the end user expectations.



Define a Scope of Work – What's important to you?

Some of the questions

- Network:
 - Cellular or Mesh
- Number of nodes
 - Some systems don't have price breaks for service under a set number of nodes
- What services do you want?
 - Define a sequence of operation
- Is the Network Lighting Control stand-alone or are you doing other controls or metering?
 - Metering Gas, Electric, Water, etc
 - Smart City/IoT Gunshot detection, Ambient Noise, Air Quality, Traffic, etc

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Sequence of Operation (How my lights work)

- Understand the events that cause lights to turn on/off, or dim
- Sample Sequence of Operation:
 - Turn On at Dark less than 1.5fc, turn on to 100%
 - Midnight, dim lights to 70%
 - 5 am, increase light level to 100%
 - Turn Off at Daylight greater than 1.5fc
 - Daytime override not required due to full Photo operation
- Sample with Time:
 - After 6pm, turn lights on with less than 1.5fc to 100%
 - Turn lights off when light level exceeds 1.5fc or 8am



Considering Security

- New standards like SB-327 are standards that require smart devices to include additional security measures
- Most Network Lighting Controls use secure cloud server so there is no exposure on your IT Network
- If the NLC requires an on-prem server, the lighting controls should be on their own private network
- Understand the security of the devices in the field. You should see terms like:
 - AES 128 or 256 bit encryption
 - Trust M Security
 - ISO/IEC 2700
 - FedRAMP Certification
 - Transport Layer Security (TLS) 1.2







Application Example



Mesh Network Example

User

Interface

- Network is broken up into groups or segments that report through an access point
- Access point uploads data to the cloud for user access via the web
- System may use repeaters (Relay) to reach areas that may be out of range for the segment



Cellular Network Example

- Network is comprised of all nodes directly connecting to a mobile network
- Repeaters are not needed in this application











Conclusion



Outdoor Lighting Controls Takeaways

- Fixture replacement is no longer the easiest way to increase ROI
- Technology like DALI has migrated to the outdoor platform
- Low Voltage devices increase expected life
- Consider the difference between measured & perceived light level
- Fixture data helps to minimize truck roles and increases safety for maintenance crews





Outdoor Lighting Controls Takeaways

- Bluetooth is a good solution for systems with scheduling that are not connected to a network continuously
- Cellular and Mesh networks are better for continuously connected networks
- Network Lighting controls enable alerts, diagnostics, controls, Smart City applications, and so much more
- Developing a specification and sequence of operation is the first step in assessing the needs of your system
- Network Security needs to be considered





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