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The Value of Embedded Lighting Controls



AIA Provider # J618

AIA Program # AB2111 1.0 LU

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Course Description

Small control zones provide increased application flexibility and granularity of control. Embedded controls are redefining how spaces are designed to meet the ever-changing needs of today's building. This course will demonstrate the importance of embedded lighting controls focusing on design, specification, and installation delivering significant value to customers.

Learning Objectives

1. Define embedded controls and their place in the market
2. Recognize the value of embedded lighting controls
3. Demonstrate the true cost of embedded controls for an application
4. Identify how to select and specify the right controls for your space

What is an Embedded Lighting Control?

Code Compliant solution that simplifies design and installation, reducing design and installation costs, while providing unmatched application and fixture choice flexibility, coupled with unequalled ease for reconfiguration and reprogramming



1

Current Trends in Lighting Controls

Trends Driving Change - Increase in Embedded Controls

- Current studies show an increased preference toward embedded controls
- Department of Energy (DOE) and Design Lights Consortium (DLC) published papers showing the increased benefits of using embedded controls
- Energy Codes are beginning to recognize embedded controls as an acceptable method. In many cases this is referred to as Luminaire Level Control (LLLC)
- Wireless lighting controls



Source: Design Lights Consortium®, “Energy Savings from Networked Lighting Control (NLC) Systems with and without LLLC”
<https://www.designlights.org/news-events/webinars/energy-savings-from-networked-lighting-control-systems-with-and-without-lllc/>

NORTH AMERICA LIGHTING CONTROLS MARKET

Connected Lighting Systems Revenue by Building Type, North America: 2019-2028



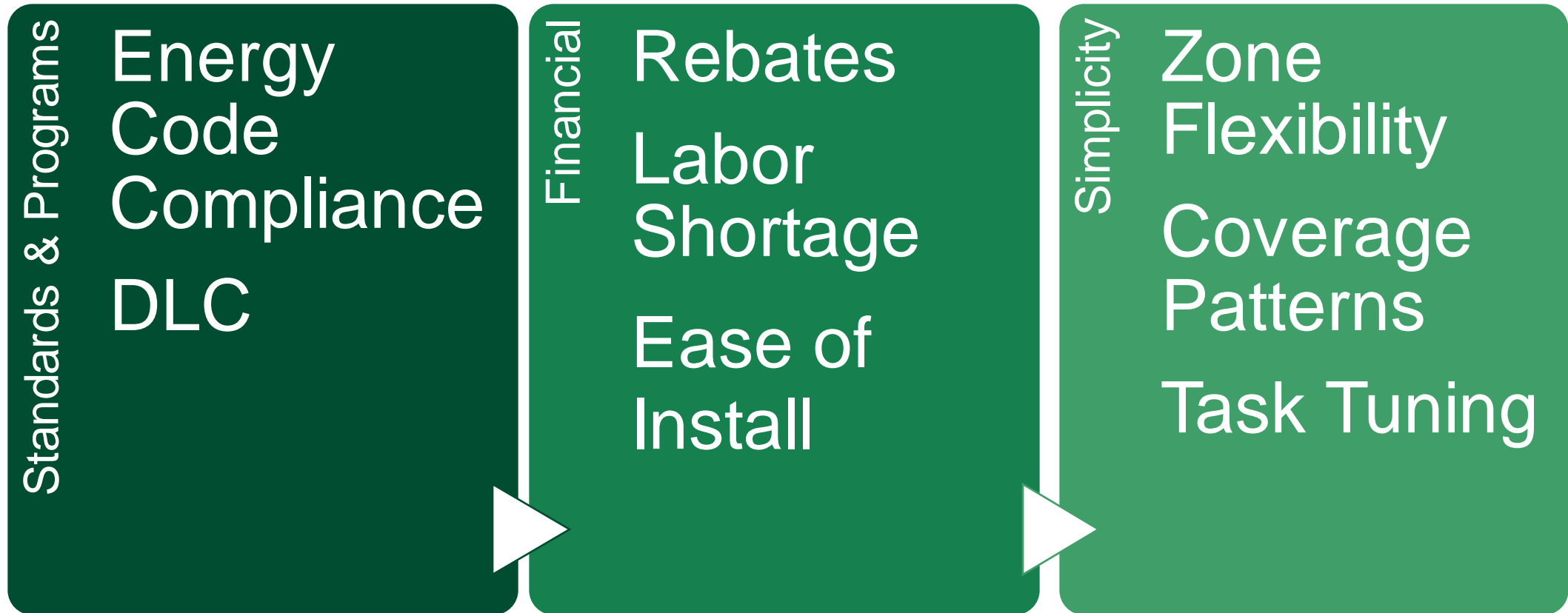
17.8%

“LED-based lighting system with integrated sensors and controllers that are networked”

Source: Navigant Research

Trends Driving Change - Increase in Embedded Controls

Why is it a current trend?



LLLC - Luminaire Level Lighting Controls

Energy Codes

- C405.2 Lighting Controls (Mandatory) – International Energy Conservation Code (IECC) introduced Luminaire Level Lighting Controls (LLLC)
- **Requirements:**
 - The ability to actively control lighting intensity when occupied or unoccupied
 - Provide the ability to respond to daylight harvesting and maintain desired light level
 - Adjust max/min trim settings and fade rates
 - Allow for remote configuration of other setting

DLC defines LLLC or integrated control as the “capability to have a networked occupancy sensor and ambient light sensor installed for each luminaire or kit, and directly integrated or embedded into the form factor during the luminaire or kit manufacturing process.



Utility Rebate Programs

Sample Utility Rebate Programs

- Utility rebate programs enable energy efficient retrofits
- Retrofits enable lower maintenance installations
- Newer rebate programs encourage enhanced control scenarios that would typically be found in new construction specifications

Fixtures with Traditional Controls Installation

Area Category	Incentive \$
Interior (watts per sq.ft.)	\$1.50 per watt saved
Exterior (watts per sq.ft. or linear ft.)	\$1.50 per watt saved



Fixture Embedded Controls Installation

Area Category	Incentive \$
Interior (watts per sq.ft.)	\$2.00 per watt saved
Exterior (watts per sq.ft. or linear ft.)	\$2.00 per watt saved



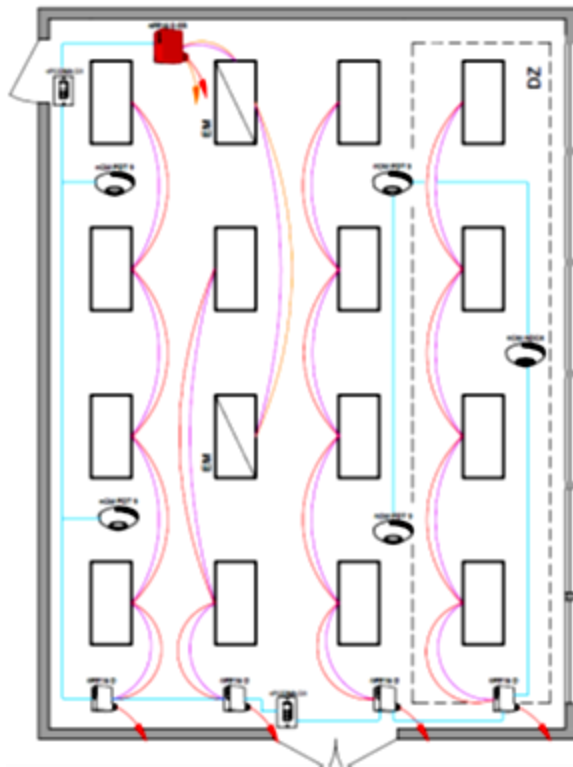
Embedded Installation with Network Lighting Controls

Area Category	Incentive \$
Interior (watts per sq.ft.)	\$3.00 per watt saved
Exterior (watts per sq.ft. or linear ft.)	\$3.00 per watt saved

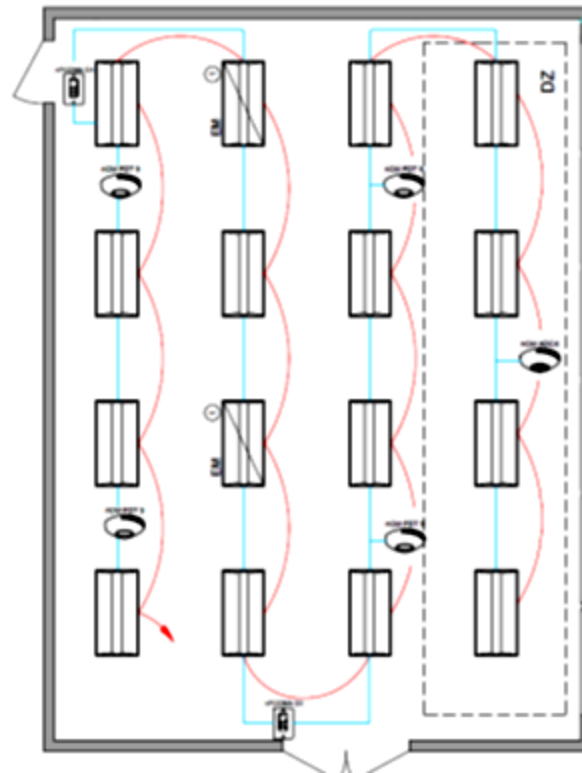
What are Embedded Controls

Application Simplification

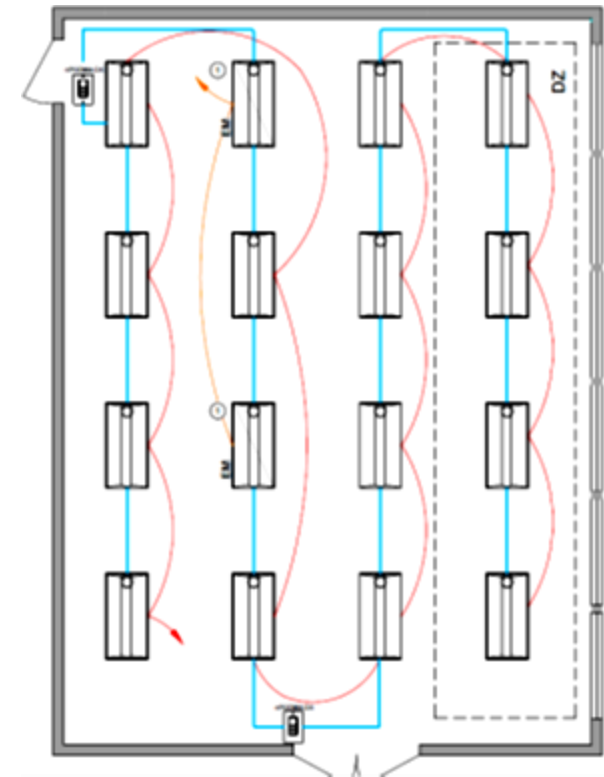
Instead of using 0-10V or power packs, fixtures use embedded controls to connect to a room network of device



Typical Application



Embedded Controls
w/sensors

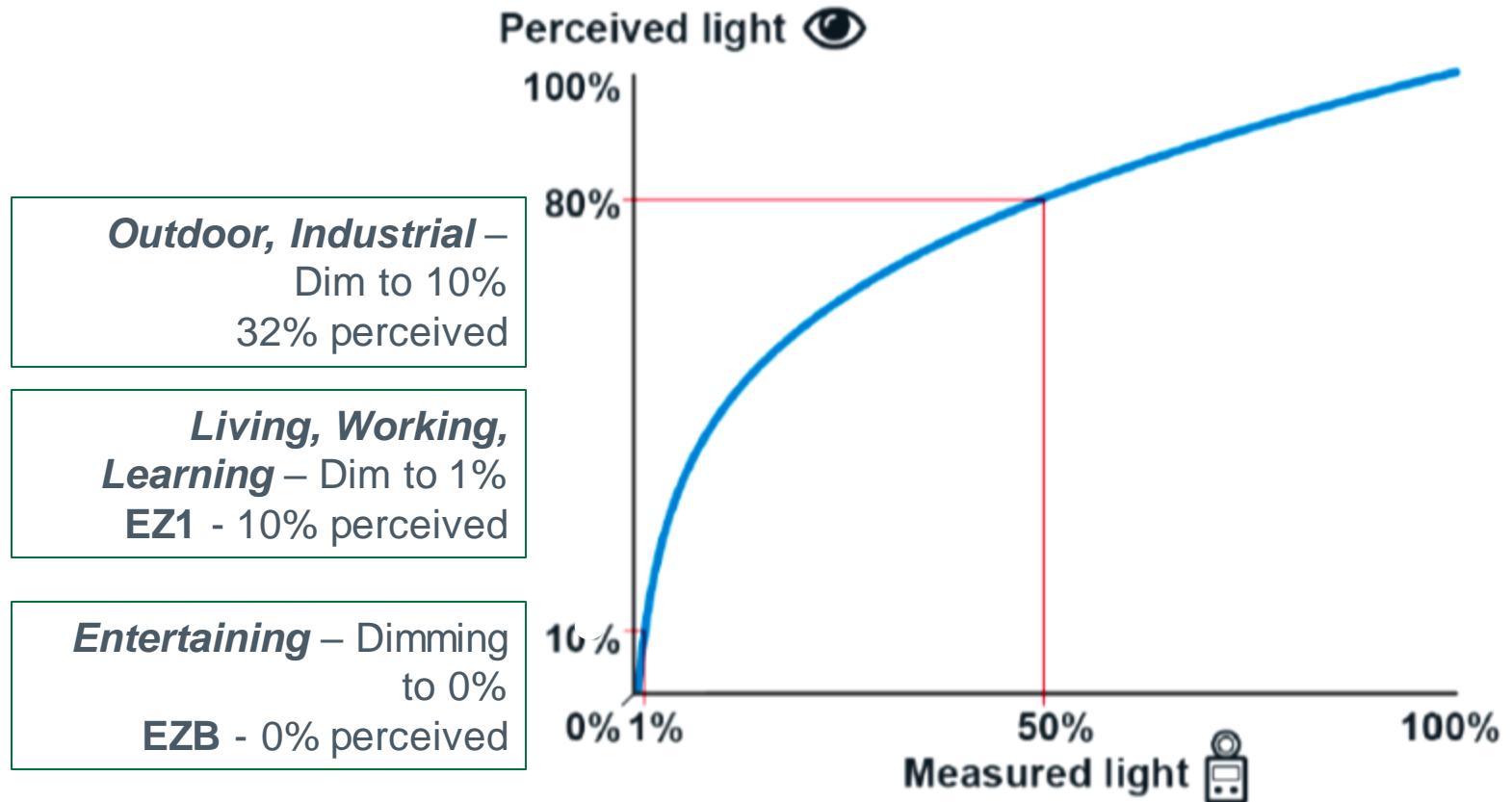


Embedded Sensors

The Value of Embedded Controls

Task Tuning

- Many Utilities and rebates are requiring the ability to “task tune” the application
- Task tuning is the ability to set the High-End trim of Light Fixture
- Task tuning can increase energy savings without a significant compromise to designed light levels





2

The Value of Embedded Controls

Photography Conversion to Digital

Analog vs. Digital



The Value of Embedded Controls

Five Things to Consider:

- Sequence of Operation
- Design Flexibility
- Cost Competitiveness
- Total Install Cost
- Planning for Optimal Coverage

The Value of Embedded Controls

Sequence of Operations

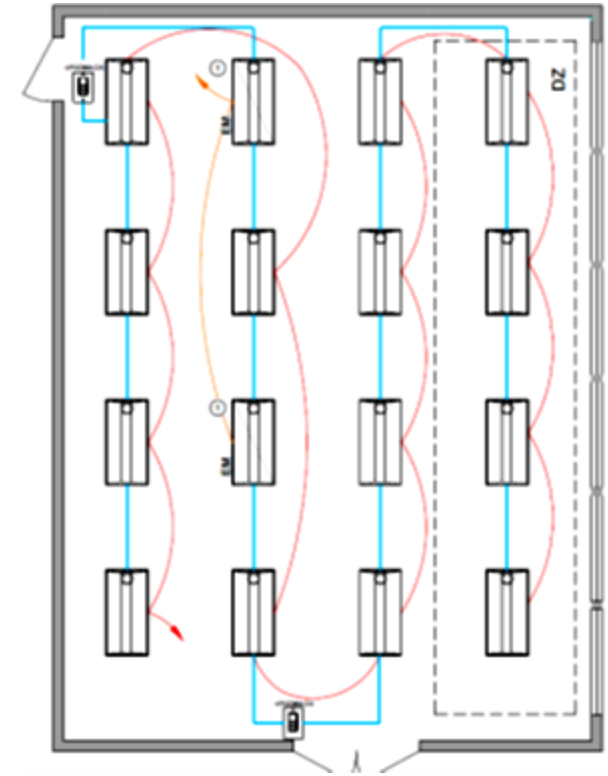
- All projects require a controls sequence of operation
- Dictates how the controls are intended to work
- Sequence of operation does not always get to the commissioning agent if it's designed during the specification phase
- Many projects do not include a sequence of operation and decisions are made on the fly in the field
- Design build projects can be fast tracked to ship while Sequence of Operation is determined

SPACE TYPE	ROOM NUMBER	Manual wall switch ON	Manual Wall Switch OFF	Dimming Wall Switch	Override Switch	Multi Zone Switch	Emergency Key Switch	Timed Switch ON	Timed Switch OFF	Night mode/ off peak setting	Occupancy Sensor ON	Occupancy Sensor OFF
Open Offices	10, 12, 14, 16									X	X	X
Private Offices	11, 13, 15	X										X
Meeting Rooms	etc.	X	X	X		X						X
Break Rooms	etc.	X										X
Kitchen	etc.	X			X				X			

The Value of Embedded Controls

Design Flexibility

- Traditional installations require powerpacks or other load controllers for each switch leg
- Embedded eliminates the need for powerpacks and panels
- Allows for in-field adjustment of lighting zones
- Contributes to fast construction without requiring completed drawings for zoning



The Value of Embedded Controls

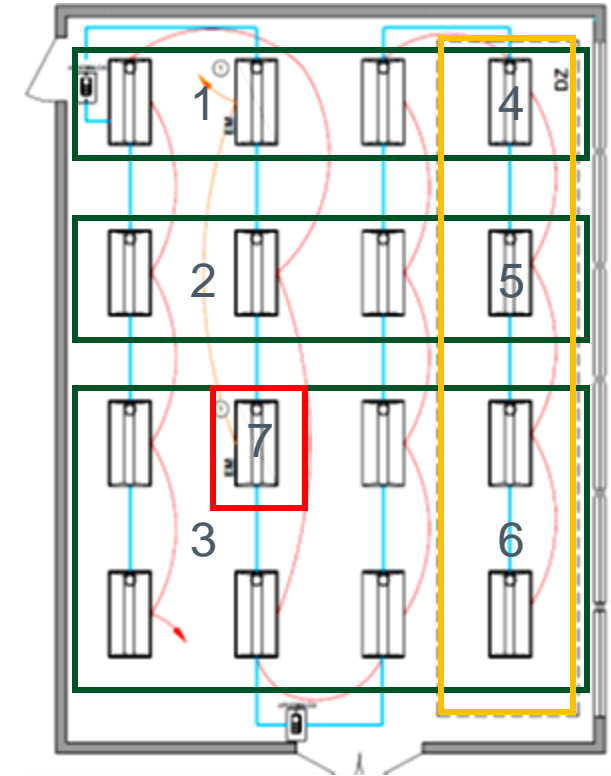
Cost Competitiveness

- Embedded control solutions can offer a **lower total cost** of ownership for installed applications
- Analyzing typical applications (office, restrooms, corridors, conference rooms, classrooms, break rooms, etc.) provide consistency in application pricing and features
- **Factors that increase total cost of installation** for non-embedded solutions:
 - Switching zones
 - Dimming
 - Daylighting zones
 - Emergency lighting
 - Etc

The Value of Embedded Controls

Total Install Cost

- Modern Lighting Control solutions have higher zoning demands than the designs of the past
- Each Zone requires a “load controller” (Powerpack, room controller, relay, etc)
- When comparing the cost of installing load controllers versus adding embedded controls to a fixture, 5 fixtures is the break even point
 - 5 or more fixtures, load controllers tend to be more cost effective
 - 5 or less fixtures, embedded controller are a less costly solution
 - Analysis considers cost of components and labor to install
- The example on the right would save 27% on the total install cost if a fixture embedded solution was compared to a traditional component-based installation using powerpacks and sensors



Costs the same or less to install than component-based systems

The Value of Embedded Controls

Planning for Optimal Coverage

- Personal protection during the Covid-19 pandemic exposed a limitation in lighting control solutions, Passive Infrared (PIR) coverage patterns
- Plexiglass barriers and temporary separators essentially act as walls to block the line-of-sight PIR coverage
- More sensors provide a comprehensive coverage pattern and will ensure that a sensor, or sensors, will ensure the lights stay on when the room is occupied





3

Evaluating the cost of Embedded Controls vs Components

Financials: Calculate the true cost of embedded controls

Embedded vs. Standard Installations

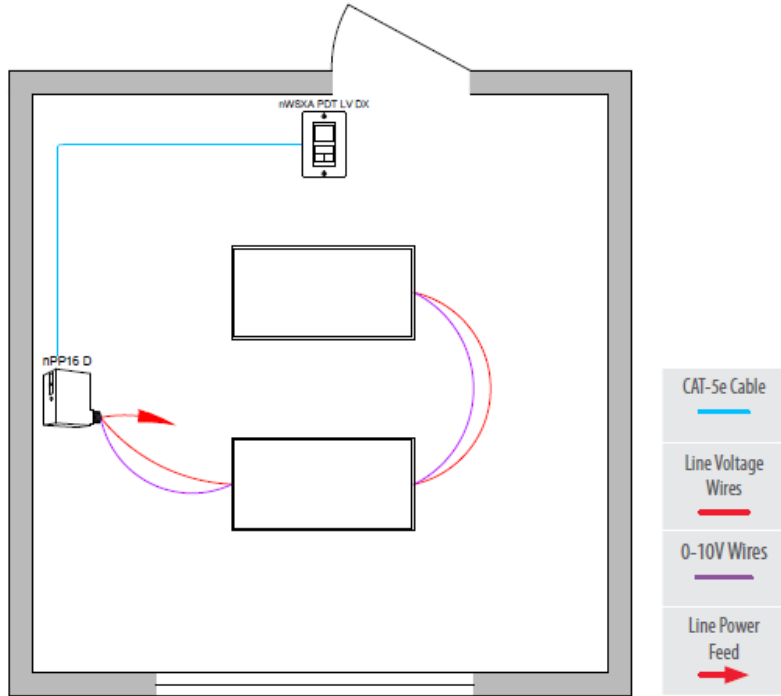
- Embedded fixtures are incrementally more costly to purchase (not double)
- No need for powerpacks
- Wireless or pre-terminated Cat-5 cables create fixture communication
- Fixtures do not have on board control capabilities
- Powerpacks need installed and wired to control each switchleg
- Zones are hard-wired using 0-10V and line voltage for fixture communication

BUDGET

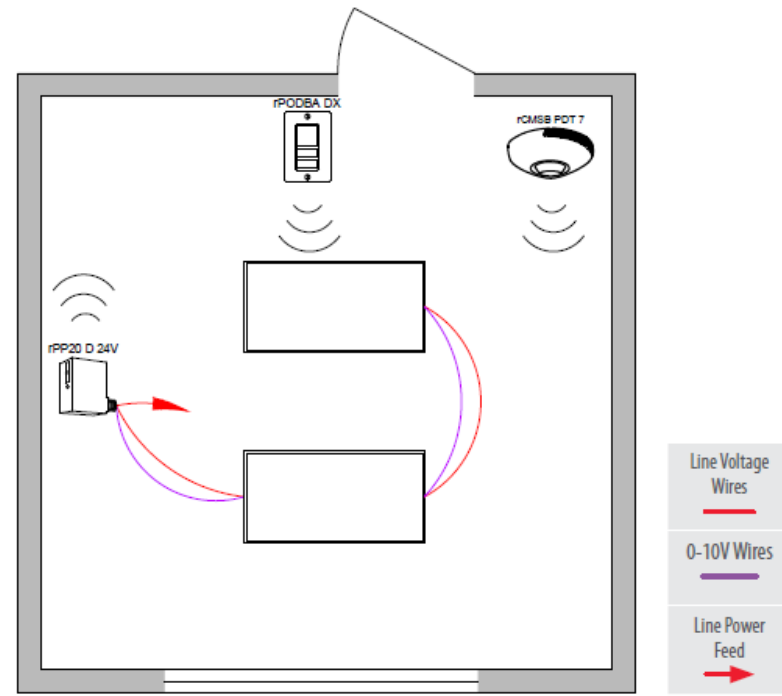


C405.2.1 Example: Enclosed Office (0-10V Fixtures)



Wired






Wireless



Bill of Materials

Symbol	Qty	Product #	Description
	1	nPP16 D EFP	Relay Pack with 0-10V Dimming Output
	1	nWSXA PDT LV DX	Wall Switch Occupancy Sensor with On/Off, Raise/Lower

Bill of Materials

Symbol	Qty	Product #	Description
	1	rPP20 D 24V EFP G2	Relay Pack with 0-10V Dimming Output
	1	rPODBA DX G2	Battery Powered, On/Off, Raise/Lower WallPod
	1	rCMSB PDT 7 G2	Battery Powered Occupancy Sensor

Cost: \$285

Fixture Adder: \$0

Devices: \$275

CAT5e: \$10

Labor: \$\$\$

Cost: \$300

Fixtures Adder: \$0

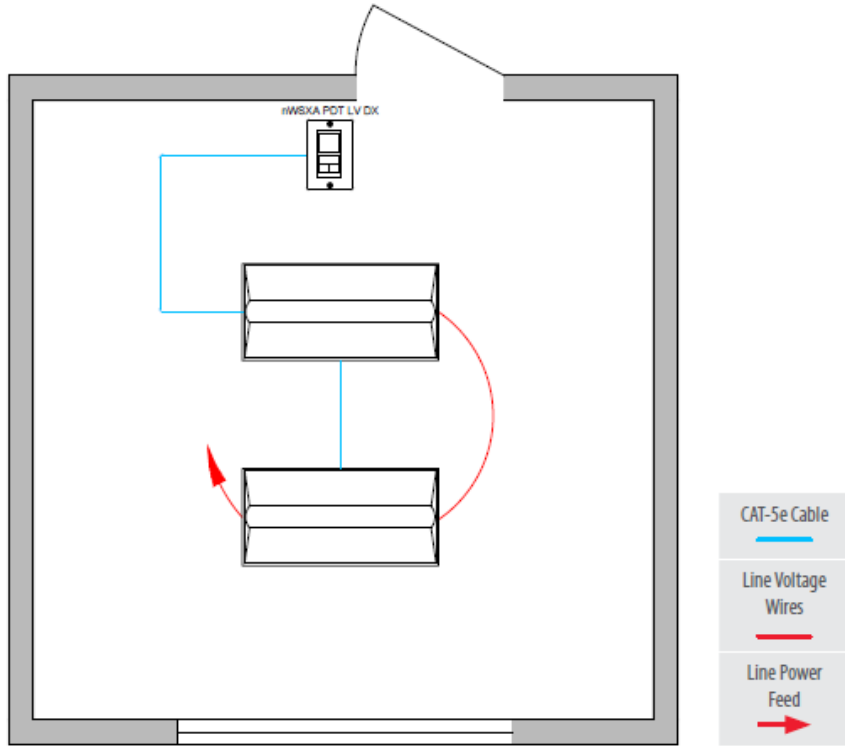
Devices: \$300

CAT5e: \$0

Labor: \$\$

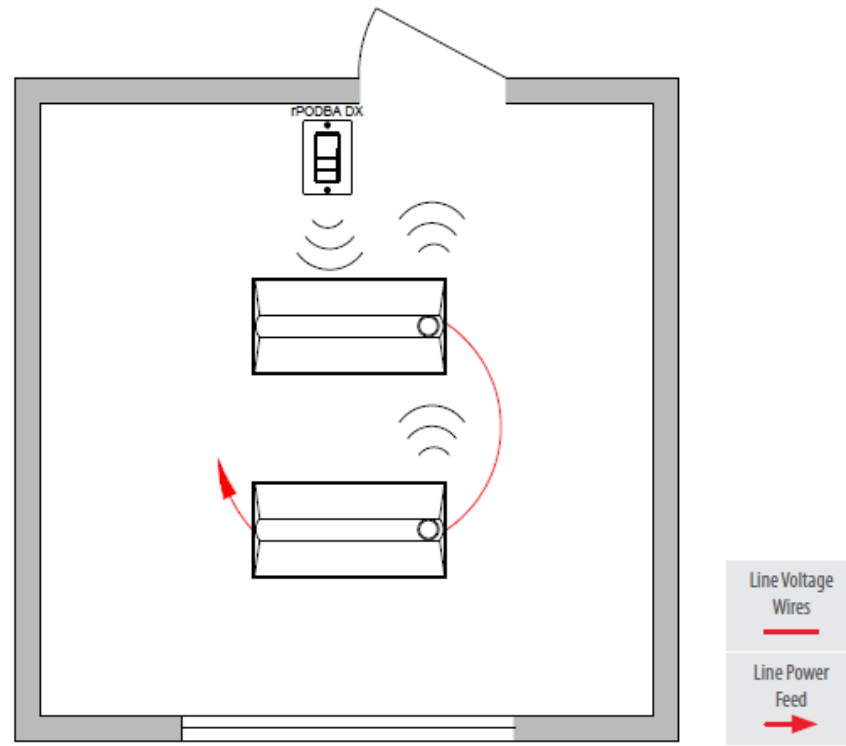
C405.2.1 Example: Enclosed Office (Enabled Fixtures)

Wired



- CAT-5e Cable
- Line Voltage Wires
- Line Power Feed

Wireless



- Line Voltage Wires
- Line Power Feed

Cost: \$310

Fixture Adder: \$150

Devices: \$150

CAT5e: \$10

Labor: \$\$

Bill of Materials

Symbol	Qty	Product #	Description
	2	See Note	nLight Wired Enabled Troffer
	1	nWSXA PDT LV DX	Wall Switch Occupancy Sensor with On/Off, Raise/Lower

Bill of Materials

Symbol	Qty	Product #	Description
	2	See Note	nLight AIR Enabled Troffer with Sensor Option
	1	rPODBA DX G2	Battery Powered, On/Off, Raise/Lower WallPod®

Cost: \$225

Fixtures Adder: \$150

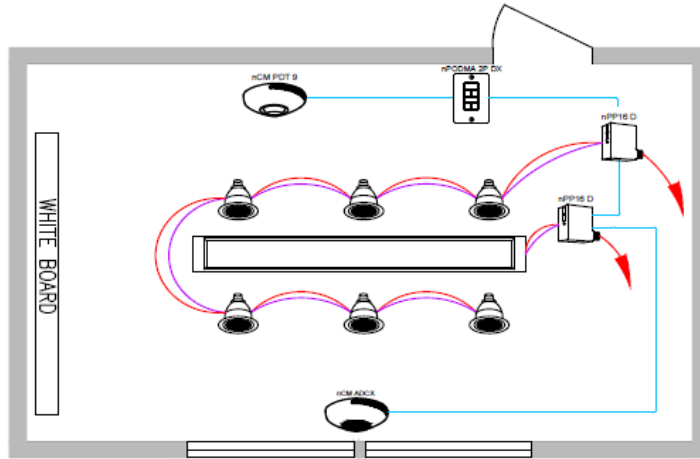
Devices: \$75

CAT5e: \$0

Labor: \$

C405.2.1 Example: Conference Room (0-10V Fixtures)

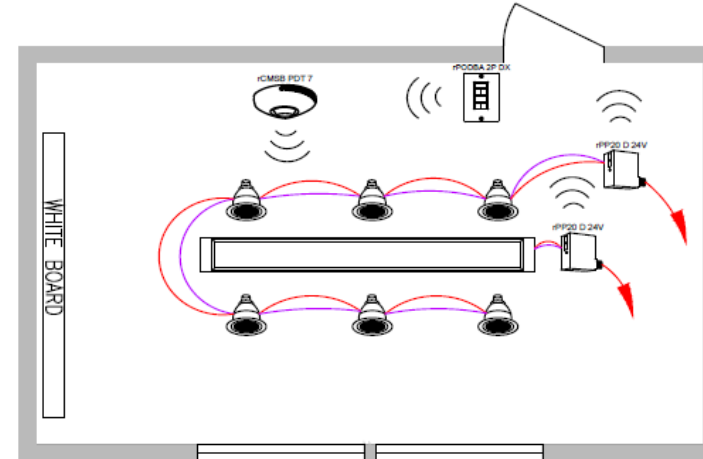
Wired



Bill of Materials

Symbol	Qty	Product #	Description
	2	nPP16 D EFP	Relay Pack with 0-10V Dimming Output
	1	nPODMA 2P DX	2-Pole, On/Off, Raise/Lower WallPod
	1	nCM PDT 9 RJB	Occupancy Sensor
	1	nCM ADCX RJB	Daylight Sensor

Wireless



Bill of Materials

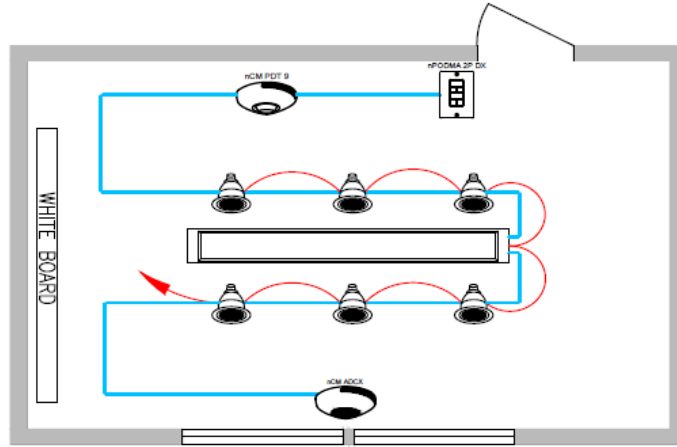
Symbol	Qty	Product #	Description
	2	rPP20 D 24V EFP G2	Relay Pack with 0-10V Dimming Output
	1	rPODBA 2P DX G2	Battery Powered, 2-Pole, On/Off, Raise/Lower WallPod
	1	rCMSB PDT 7 G2	Battery Powered Occupancy and Daylight Sensor

Cost: \$750
 Fixture Adder: \$0
 Devices: \$725
 CAT5e: \$25
Labor: \$\$\$

Cost: \$450
 Fixtures Adder: \$0
 Devices: \$450
 CAT5e: \$0
 Labor: \$\$

C405.2.1 Example: Conference Room (Enabled Fixtures)

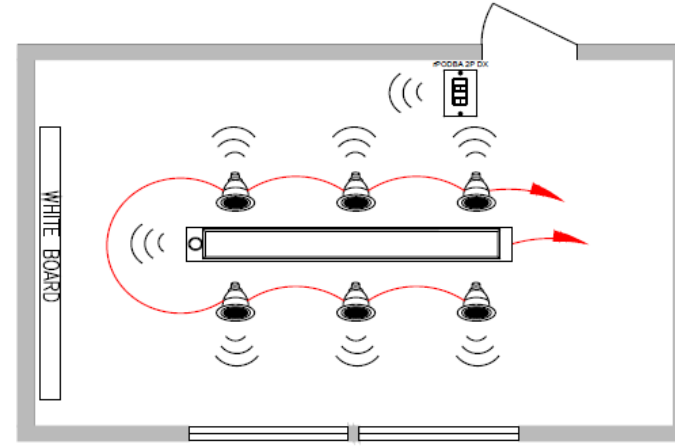
Wired



Bill of Materials

Symbol	Qty	Product #	Description
	1	See Note	nLight Wired Enabled Linear Fixture
	6	See Note	nLight Wired Enabled Downlight Fixture
	1	nPODMA 2P DX	2-Pole, On/Off, Raise/Lower WallPod
	1	nCM PDT 9 RJB	Occupancy Sensor
	1	nCM ADCX RJB	Daylight Sensor

Wireless



Bill of Materials

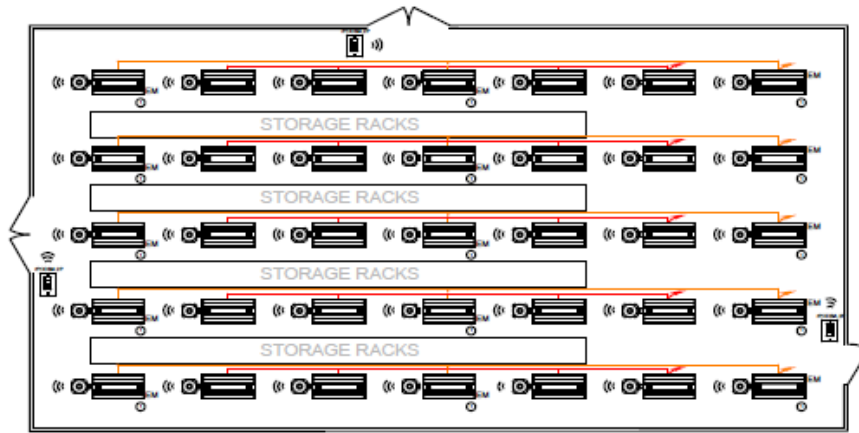
Symbol	Qty	Product #	Description
	1	See Note	nLight AIR Enabled Linear Fixture with Sensor Option
	6	See Note	nLight AIR Enabled Downlight Fixture
	1	rPODBA 2P DX G2	Battery Powered, 2-Pole, On/Off, Raise/Lower WallPod

Cost: \$850
 Fixture Adder: \$350
 Devices: \$475
 CAT5e: \$25
 Labor: \$\$

Cost: \$400
 Fixtures Adder: \$350
 Devices: \$50
 CAT5e: \$0
Labor: \$

C405.2.1 Example: Warehouse

Wireless with nLight Enabled Fixtures



Bill of Materials

Symbol	Qty	Product #	Description
	20	See Note	nLight AIR Enabled High Bay Fixture with Sensor Option
	15	See Note	nLight AIR Enabled High Bay Fixture with Sensor and EM Option
	3	rPODBA 2P G2	Battery Powered, 2-Pole, On/Off WallPod

Cost: \$1900

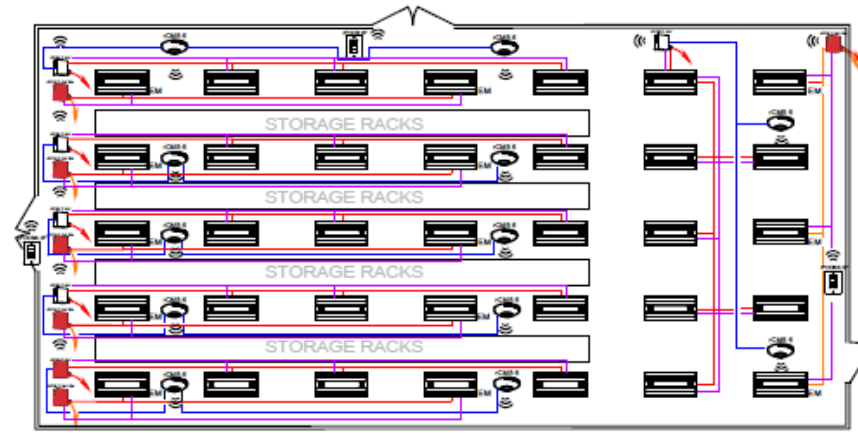
Fixture Adder: \$1750

Devices: \$150

CAT5e: \$0

Labor: \$

Wireless with 0-10V Dimming Fixtures



Bill of Materials

Symbol	Qty	Product #	Description
	6	rPP20 D 24V EFP G2	Relay Pack with 0-10V Dimming Output
	6	rPP20 D 24V EM EFP G2	Emergency Relay Pack with 0-10V Dimming Output
	3	rPODBA 2P G2	Battery Powered, 2-Pole, On/Off WallPod
	12	rCMS 6 G2	Occupancy Sensor

Cost: \$3450

Fixtures Adder: \$0

Devices: \$3450

CAT5e: \$0

Labor: \$\$\$\$



4

How to Specify the right solution

How to Specify/Design

Embedded controls can be viewed as an alternate or equal to traditional lighting controls

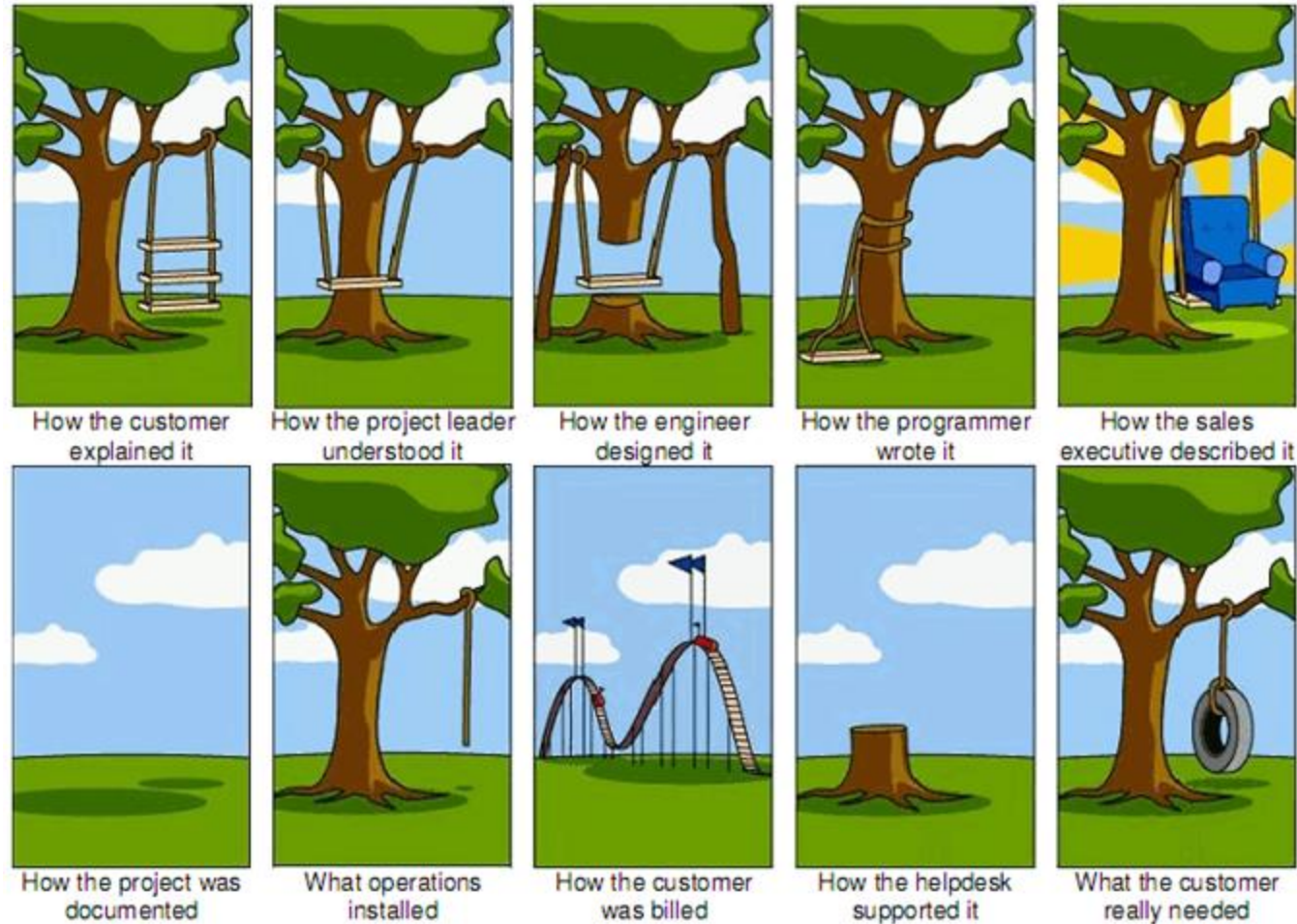
or

Embedded controls can be a specified solution on its own

The Value of Embedded Controls

Specify

PERFORMANCE



PRESCRIPTIVE

The Value of Embedded Controls

Competitive cross



- Many manufacturers provide an embedded option, and some are integrated
 - Embedded (as defined by DLC) is internal
 - Integrated is attached to the fixture
- UL requires fixtures to be labeled with all the components they contain including controls, drivers, and light engines
- If a manufacturer did not design a fixture with embedded controls initially
 - It will have to go back through UL for approval
 - UL will cause delays in availability
 - Each unique control option will have to be UL Listed.

The Value of Embedded Controls

Specification Takeaways

- Specifications can be product specific, or performance based
- Embedded can be used as a cross to traditional lighting control installations
- Manufacturers must have their fixtures approved with all control options
- Manufacturers are including more control options everyday
- Embedded can enhance energy savings or enable additional features

The Value of Embedded Controls

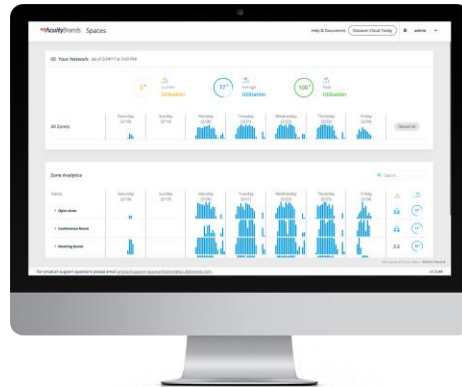
Future Considerations for embedded controls



Real Time Location Services



Asset Tracking

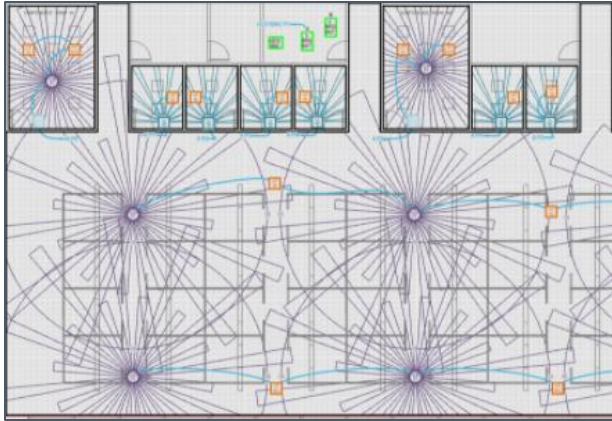


Space Utilization



Occupant Comfort

Application Design and Specification Tools



MasterSpec[®]

a product of The American Institute of Architects



Design/Layout Software

Specification Tools



Application Guides



7

Conclusion

Embedded Controls Takeaways

Embedded Controls

- Embedded controls are growing in popularity
 - Both as an embedded solution and integrated
 - Wired and wireless are seeing comparable growth
- Energy codes are beginning to push for LLC to provide more granularity of control
- Rebates are incentivizing customers to use embedded controls
- Task tuning can save additional energy while potentially extending the life of the fixture
- Embedded sensors provide an abundance of occupancy sensor coverage, so partitions or barriers do not become an issue

Embedded Controls Takeaways

Embedded Controls

- Embedded controls can be used to cross traditional lighting controls or as a control's strategy on their own
- Embedded controls are generally a lower total cost of installation than traditional controls
- Validate your manufacturer has the control solution you are looking for (product redesign and UL will delay availability)
- Use embedded as a platform for additional control option
 - Occupancy comfort
 - Space utilization
 - Real-time location services
 - etc

This concludes the continuing education portion of this course.

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Contact Information



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Q&A

Tools

- [Code/Application Guides](#)
- [Specification Tools:](#)
 - [Methodik - Sequence of Operations Tool](#)
 - [Spec Builder tool](#)
 - [Visual Controls](#)
- [Performance Specification](#)
- [Acuity Brands website](#)
- [nLight Lighting Controls System website](#)
- [Acuity Academy Courses](#)
- Continuing Education eLearning courses (Acuity Academy):
 - [Sequence of Operations](#)
 - [The Value of Networked Lighting Controls](#)
- Videos:
 - [nLight Lighting Controls Platform – Not All Lighting Controls Systems Are Created Equal](#)
 - [nLight® AIR Wireless Lighting Controls System - Overview](#)
 - [nLight® AIR Autonomous Bridging Technology](#)
 - [Simplify Lighting & Controls with nLight® Enabled Luminaires](#)



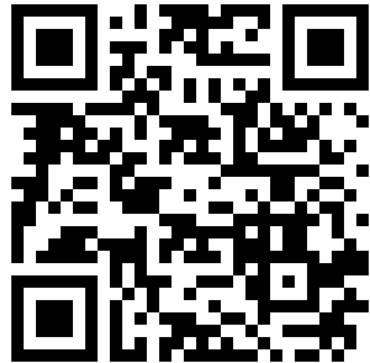
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