Ameren Illinois Energy Efficiency Program

Power Lunch

June 8, 2022

Networked Lighting Controls

Steve Mesh professional affiliations

Illuminating Engineering Society

Northeast Regional Vice President, 2007-2008

Energy Management Committee member for 25 years

Former Quality of the Visual Environment Committee member

IES/New York section Education Committee chairperson, 1999-2001

International Association of Lighting Designers

Former IALD Corporate Member

1997 Intern Program administrator

American Institute of Architects

AIA Registered Provider, 2003-2008

- **Invited speaker:**
  - LightFair (1992, 2007-2013, 2016, 2017, 2020)
  - Lux Pacifica (New Delhi, India – 2002)

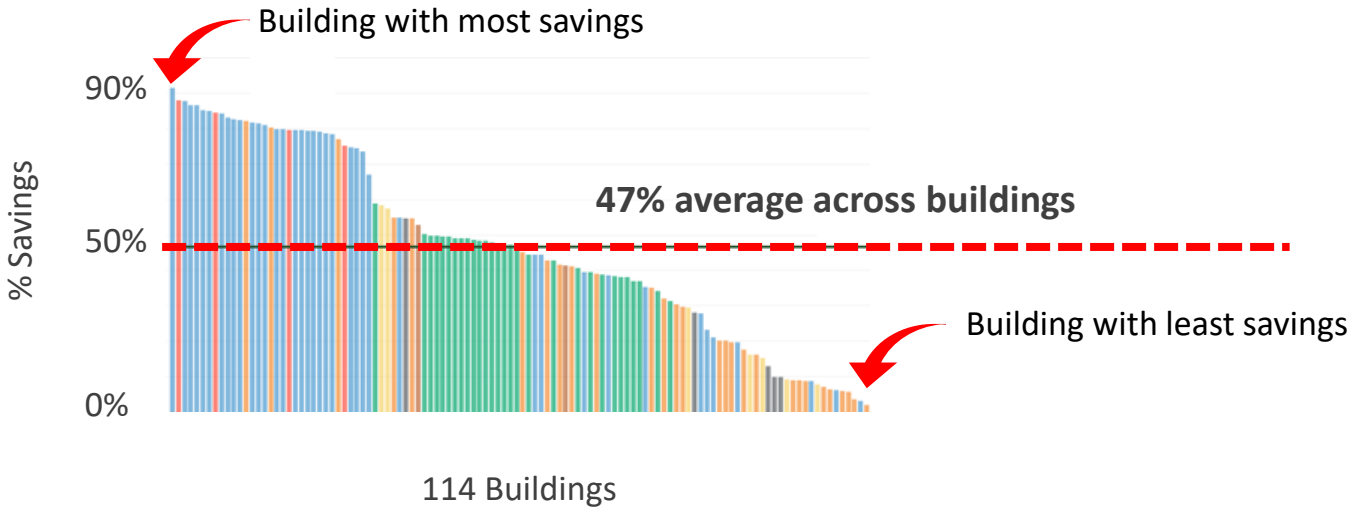
LC:

- "Lighting Certified"
- "Item Writer"

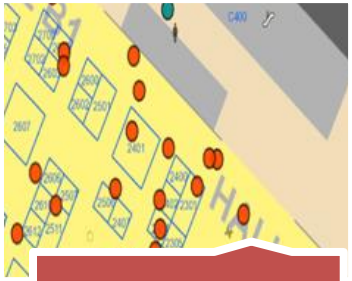
Young Eagles pilot

DLC (DesignLights Consortium) study

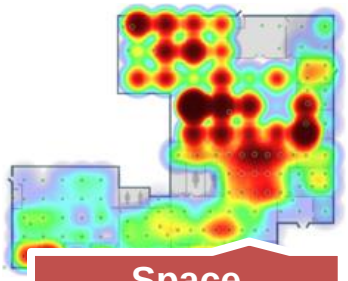
- Average savings in lighting energy from lighting controls – **47%**
- Data was from voluntary contributions
- Individual buildings: lighting control savings ranged from **2%-90%**
- Search “DLC Energy Savings Report” online to download the full report and webinar
- Other utility auditing groups are beginning to confirm similar values to this report’s averages



Non-energy benefits of LLLC systems



Asset Tracking



Space Utilization

Indoor Positioning

Diagnose and Report

Conference Room Scheduling

Security

Energy Tracking

Integrate with BMS/HVAC

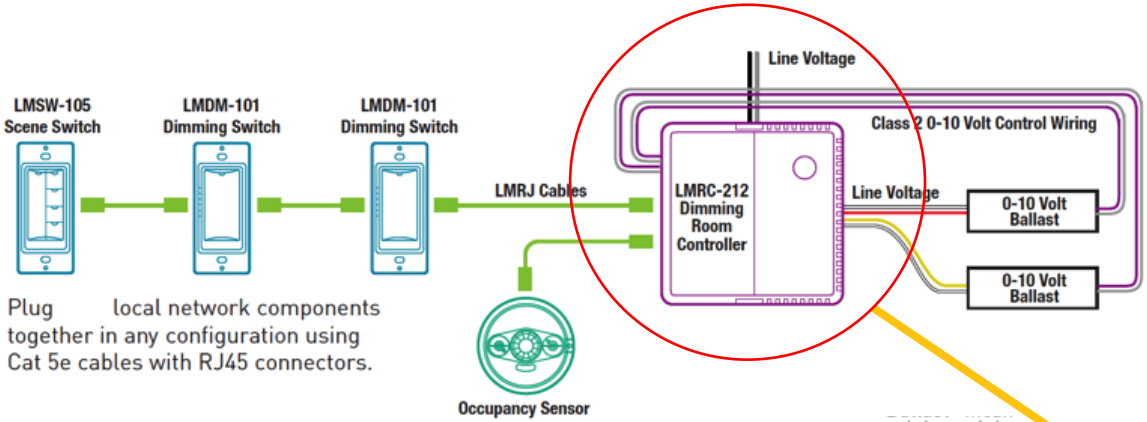
Definitions

What are Room-Based Systems?

As defined by the DesignLights Consortium …

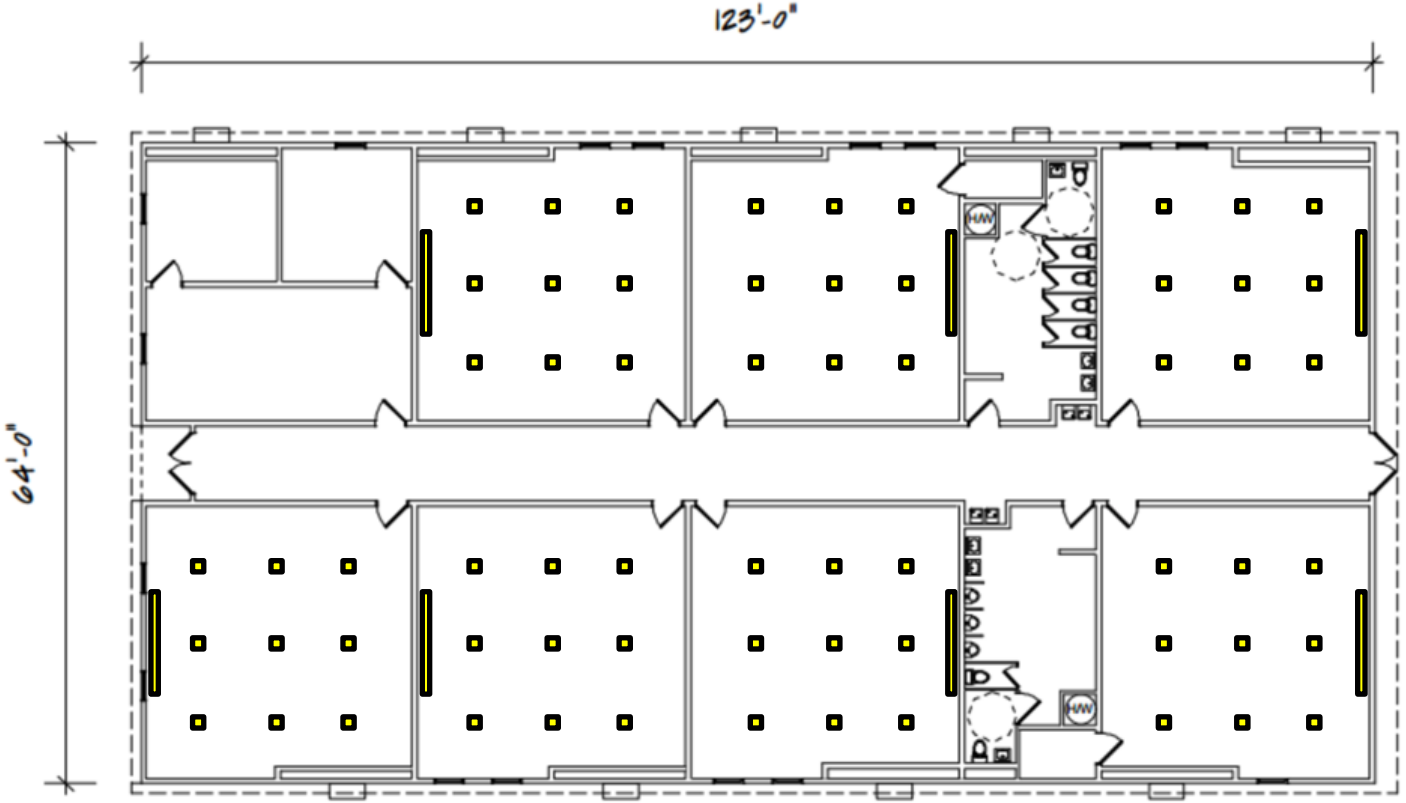
“A “room-based system” is defined as follows: A system that is designed to control lighting in a **single room or space**, and where the control, configuration, and management of the system is **contained within the room or space** illuminated by the system. In order to interact with the system, (for instance, to change any settings or to download any data), a **user must be physically present** in, or in close proximity to, the room or space illuminated by the system.”

Room-Based System Topology

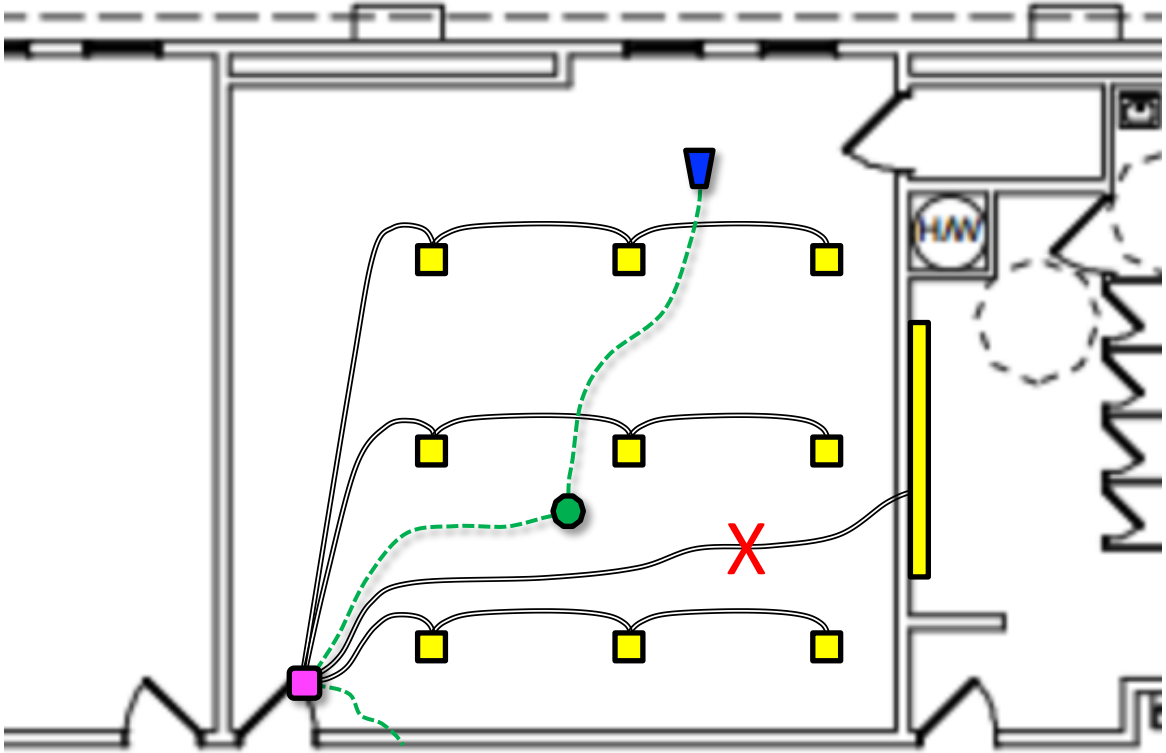


Plug local network components together in any configuration using Cat 5e cables with RJ45 connectors.

Room-Based System Topology (school example)



Room-Based System Topology



What are NLCs?

NLC = Networked Lighting Control system

As defined by the DesignLights Consortium …

"**Networked lighting control (NLC) systems:** NLC systems are lighting systems with a combination of sensors, network interfaces, and controllers that effect lighting changes in luminaires, retrofit kits, or lamps."

What are LLLCs?

LLLC = Luminaire Level Lighting Controls

As defined in the 2018 version of the Illinois Energy Conservation Code (based on IECC 2018 <International Energy Conservation Code>) …

"**LUMINAIRE-LEVEL LIGHTING CONTROLS.** A lighting system consisting of one or more luminaires with embedded lighting control logic, occupancy and ambient light sensors, wireless networking capabilities and local override switching capability, where required."

In plain English, **LLLC** means that fixtures must have:

Controller (to switch and dim)

Occupancy sensor

Photosensor

Wireless connection to network (only according to code … see next page for clarification)

What are LLLCs?

LLLCs are a type of **NLC** (Networked Lighting Control) system.
However, not all NLC systems use LLLCs (*as defined by the code*):

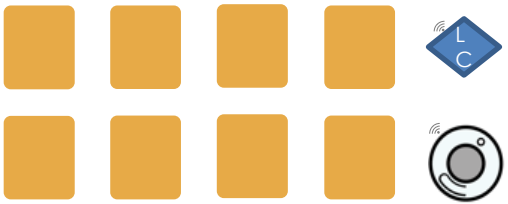
Some NLC systems with fixture-integrated controllers and sensors are **wired**.
Wired NLC systems that have fixture-integrated controllers and sensors **can still be used** in a project (even if it doesn't meet the "official" code designation of an LLLC system).
You can still get **Ameren Illinois incentives** for using these systems.
Some NLC systems – whether they are wired or wireless – do **not** use fixture-integrated sensors (or controllers). They use **zone-based** sensors and/or controllers.

Most important takeaway: regardless of whether a system uses a wired or wireless connection to the network – if it has fixture-integrated controllers and sensors, then it is considered an LLLC system by Ameren and eligible for financial incentives.

What is actually contained in each fixture?

NLC Configuration

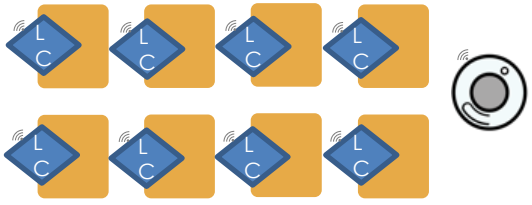
1 sensor : many fixtures



1 load controller : many fixtures

Individually Addressable

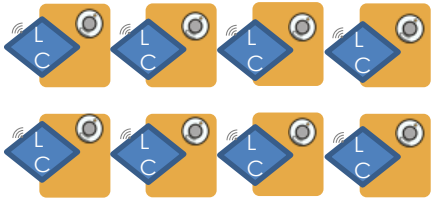
1 sensor: many fixtures



1 load controller : 1 fixtures

LLLC (also individually addressable)

1 sensor : 1 fixtures

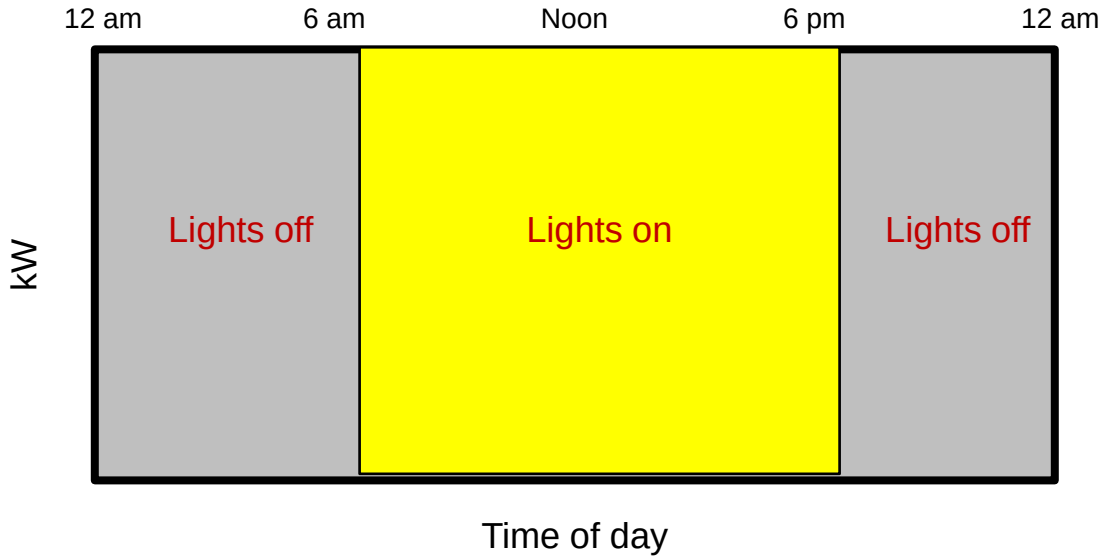


1 load controller : 1 fixtures

Courtesy of John Arthur Wilson

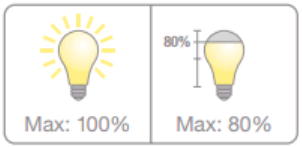
Control Strategies

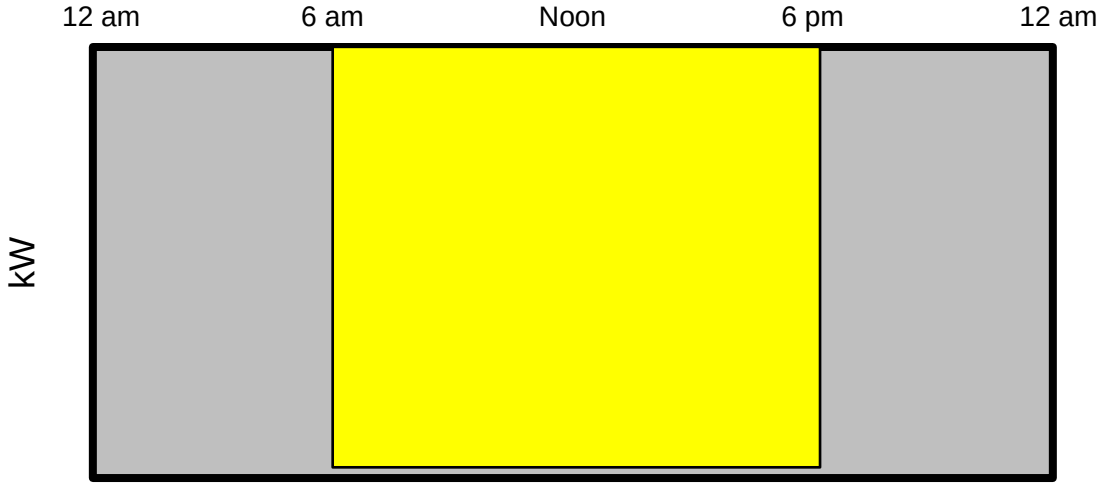
Time Scheduling



Turn off lights after hours or when a space is not normally used.

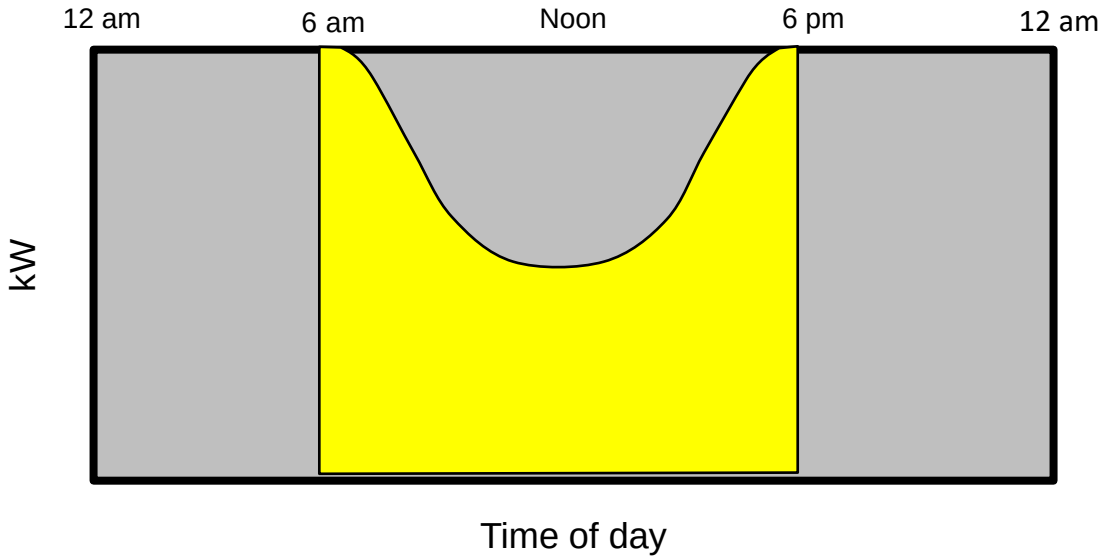
High-End Trim / Task Tuning





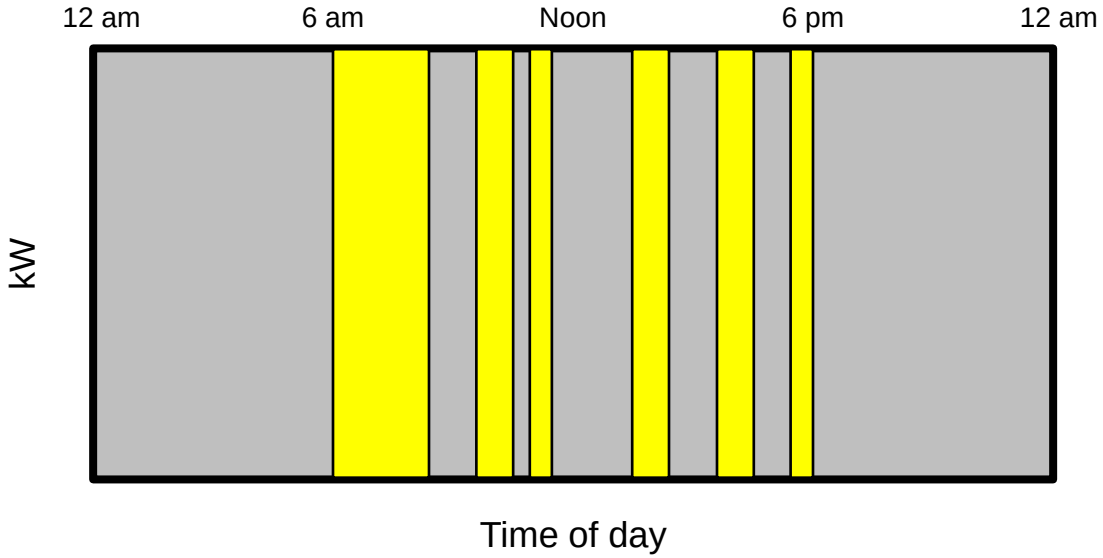
Reduce the maximum light level for an entire space or building during normal occupied hours.

Daylight Harvesting



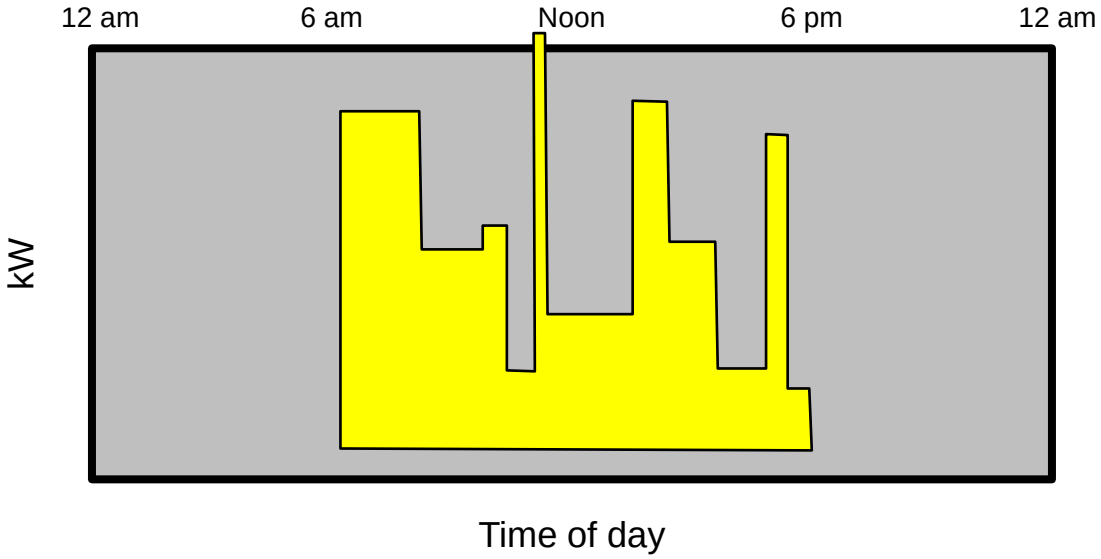
Dim or turn off lights based on available natural light.

Occupancy / Vacancy Sensing



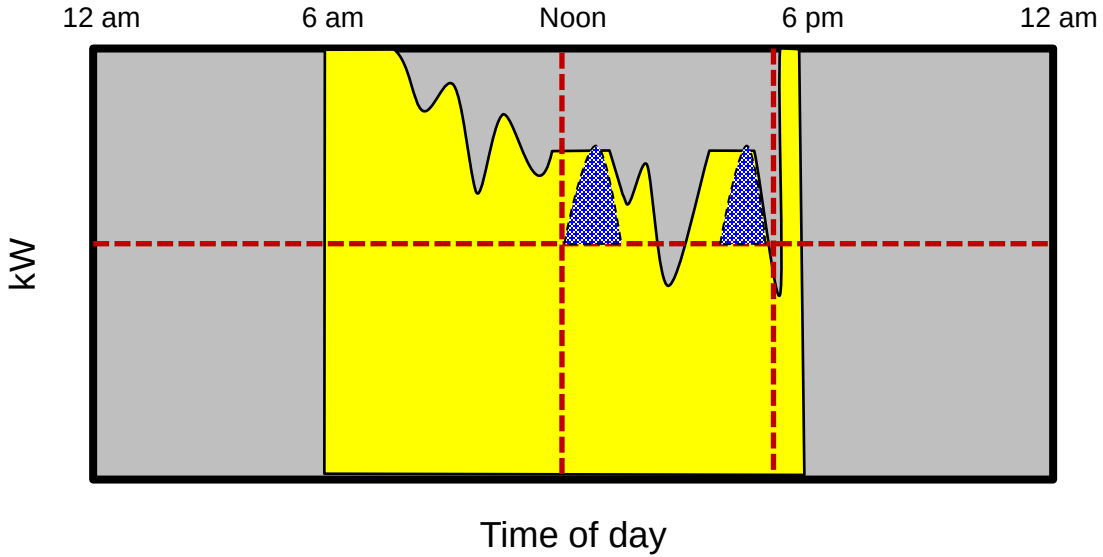
Turn off lights when the space is unoccupied (vacant).

Personal Control



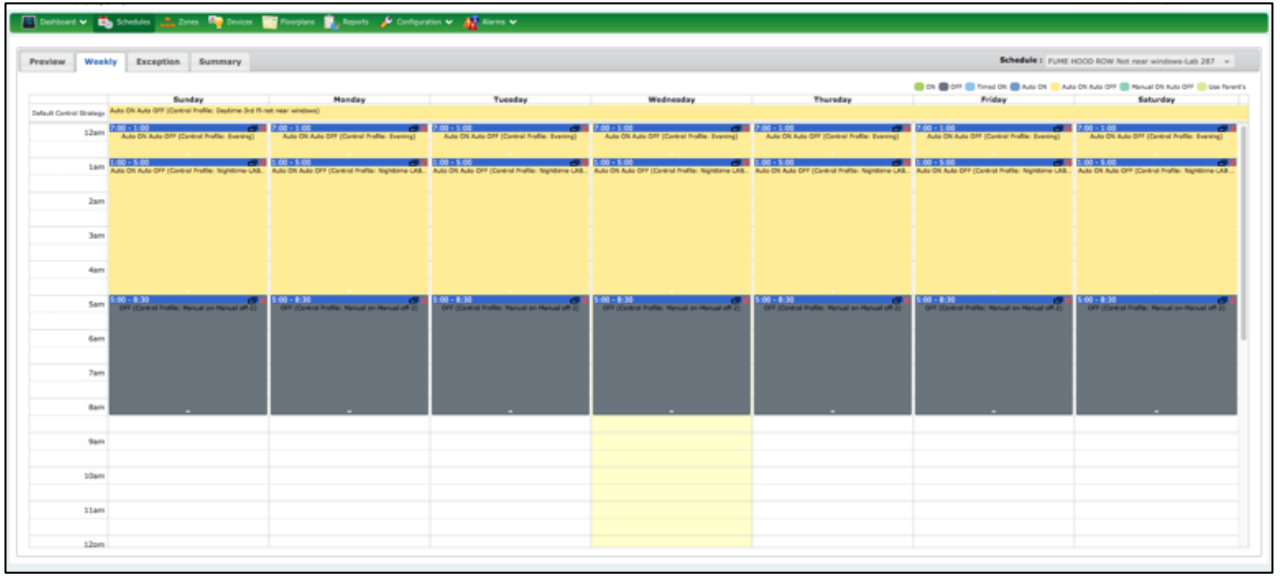
Dim or turn off lights based on personal preference or needs.

Variable Load Shedding (“Demand Response”)



Dim or turn off lights during periods of peak demand.

Time Scheduling



Sidebar Conversation
Target Light Levels

IES Illuminance Recommendations

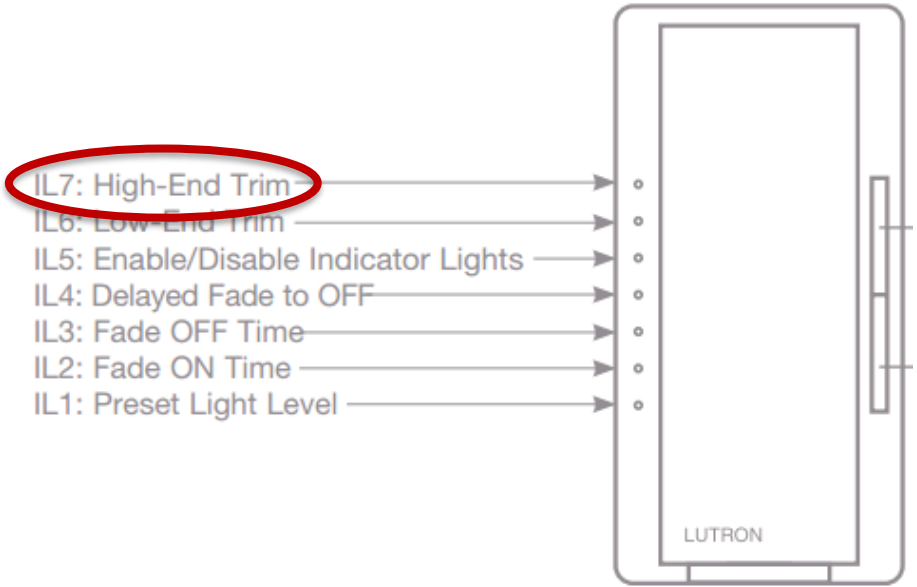
Table 24.2 | Educational Facilities Illuminance Recommendations continued from previous page

Applications and Tasks*	Notes	Recommended Maintained Illuminance Targets (lux)[b, c, d]									
		Horizontal (E_h) Targets					Vertical (E_v) Targets				
		Visual Ages of Observers (years) where at least half are					Visual Ages of Observers (years) where at least half are				
		Category	<25	25-65	>65	Gauge	Category	<25	25-65	>65	Gauge
AUDITORIA	(continued)										
• Performance	Dedicated to artistic performances (likely fixed seating); For dedicated theaters see 28 | LIGHTING FOR HOSPITALITY AND ENTERTAINMENT										
• House	As the architect coordinates contrast markings with steps, curbs, and ramps, localized lighting may be deemed appropriate.										
• During event			2	2	2	Min	F	5	10	20	Avg
• Pre/Post event		L	37.5	75	150	Avg	K	25	50	100	Avg
• Stage											
• Access ramps/stairs	See AUDITORIA/Circulation										
• Amateur productions											
• Dance (performance)	E_h @floor; E_v @5' AFF	P	150	300	600	Avg	R	250	500	1000	Avg
• Demonstration		T	500	1000	2000	Avg	R	250	500	1000	Avg
• Music		P	150	300	600	Avg	R	250	500	1000	Avg
• Theater	Simple, no stage lighting cues	P	150	300	600	Avg	P	150	300	600	Avg
• Professional productions	Stage lighting as determined by production crew; See IES DG-20-09 | Stage Lighting **A Guide to the Planning of Theatres and Auditoriums** for guidance on architectural and electrical infrastructure										
• Prefunction	Anteroom or transition space adjoining auditorium										

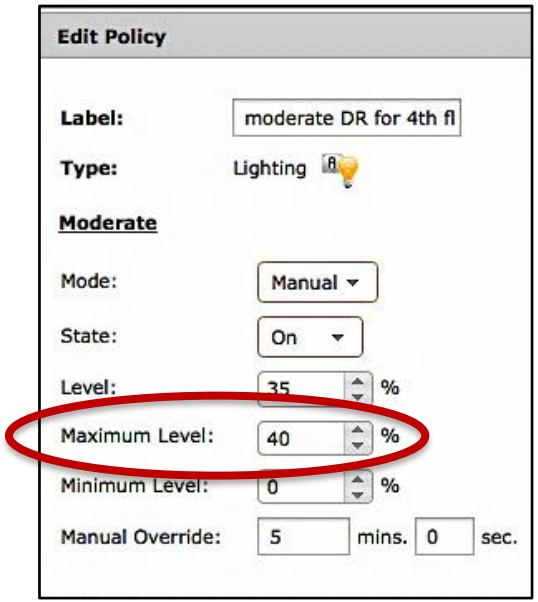
150 300 600

High-End Trim / Task Tuning

Advanced Dimmer with High-End Trim Capability



Software-based High-End Trim



Daylight Harvesting

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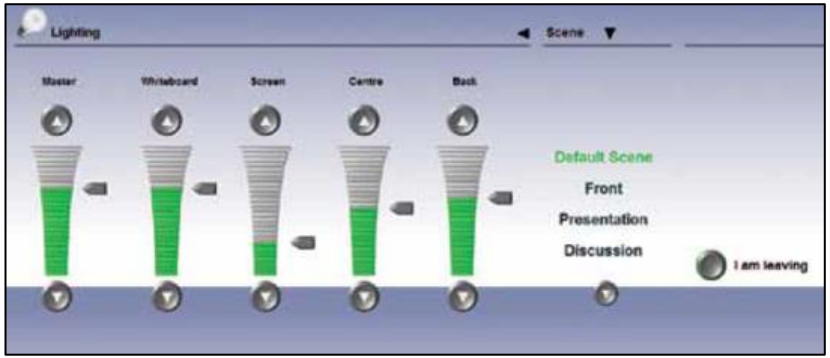
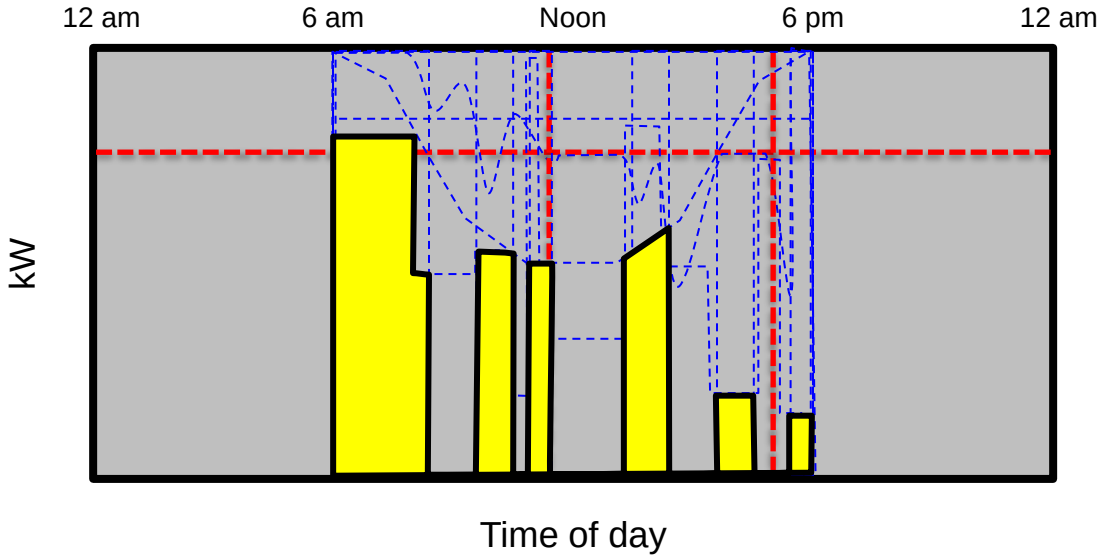


Aggregate Strategies for a Given Space



Aggregate strategies for that space, and the resulting energy use.

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Occupancy Sensor Zoning
For Open Offices

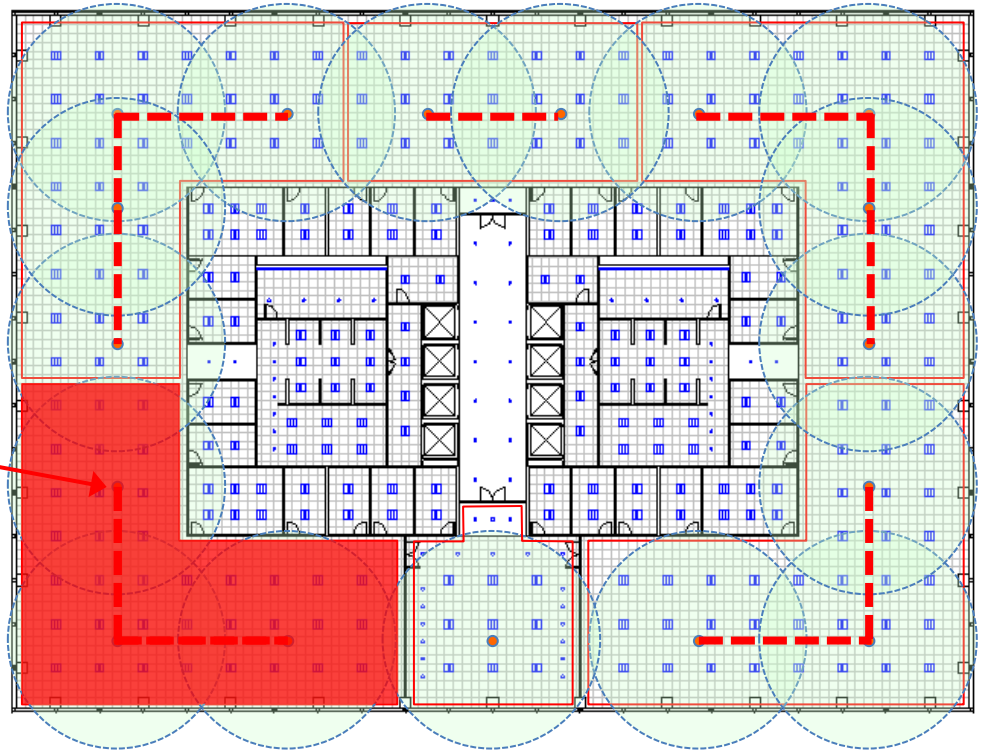
"Occupant sensor controls"

1st pass; occupancy sensors with large coverage pattern (1500 ft²/sensor)

17 occupancy sensors

6 zones (including reception; sensors would work "in parallel" in each zone)

Occupancy sensor with 1500 ft² coverage pattern



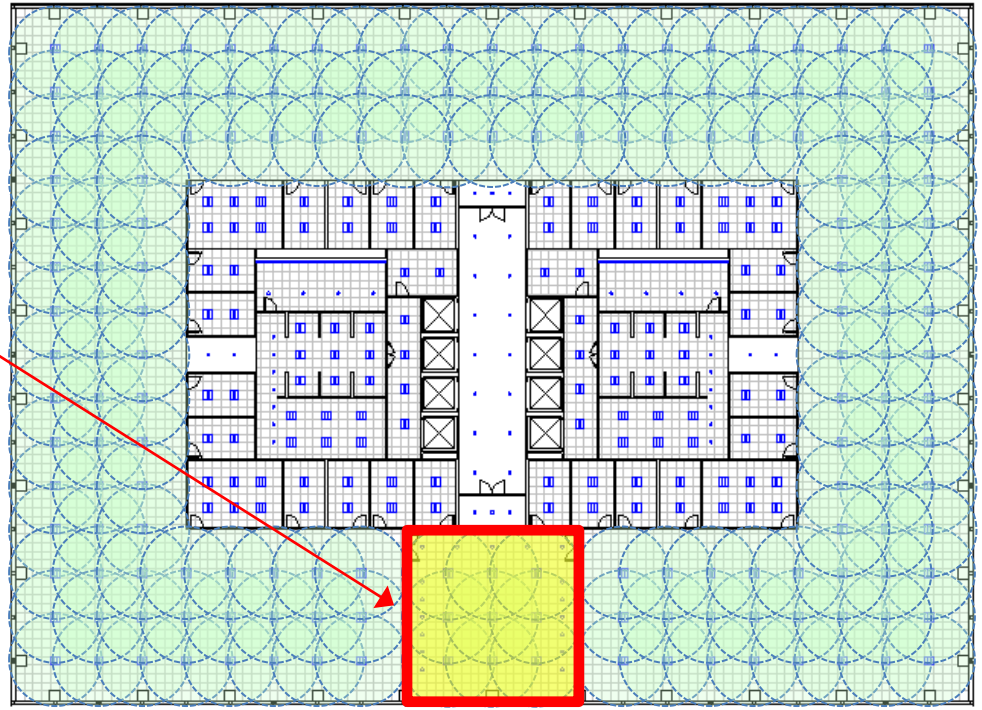
“Occupant sensor controls”

4th pass – LLLC (fixture-integrated, 100 ft²/sensor)

174 occupancy sensors

☞ With “fixture-integrated” sensors in an LLLC system, every fixture is essentially its own zone.

☞ In LLLC systems, the software allows you to “group” multiple fixtures. For example, the (9) fixtures in the partitioned reception area can be grouped so that if any fixture picks up motion, all (9) fixtures will turn on.

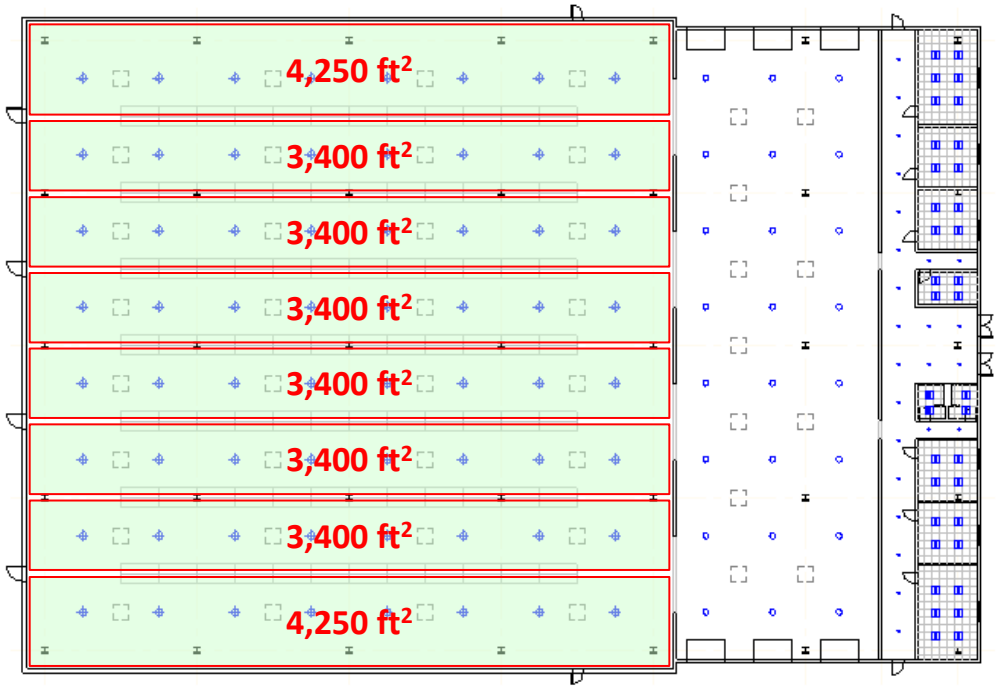


LLLC system with “pre-programmed, autonomous behavior”

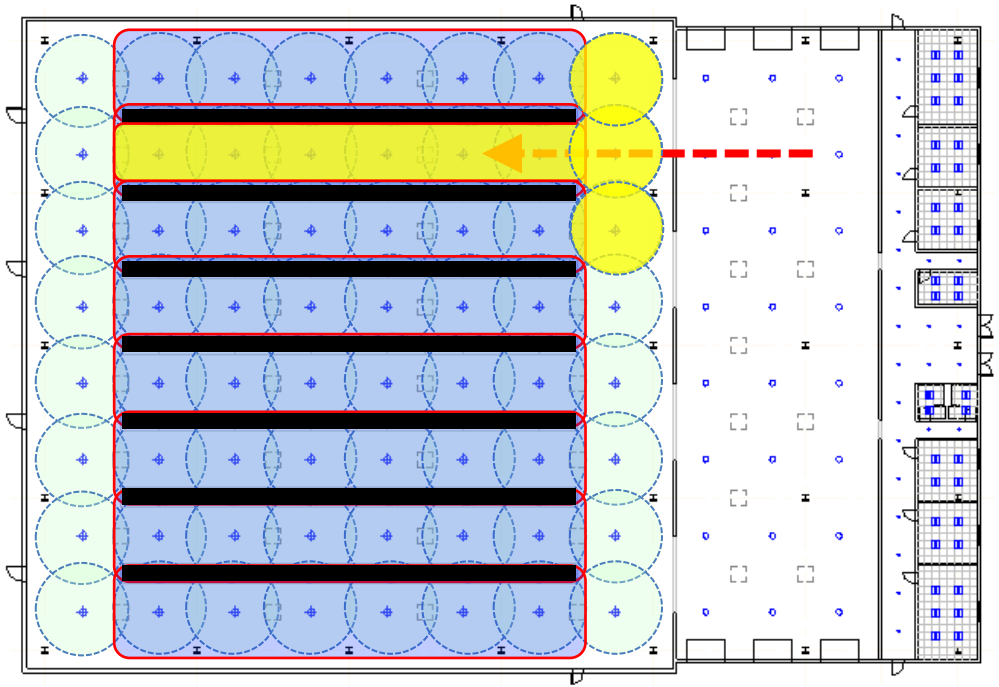
Zoning for Warehouses

Warehouse building information (41,811 ft² total area)

Warehouse zones – alternate layout



Warehouse zones – using an LLLC system with aisles grouped for occupancy sensing



LLLC System Components

LLLC – minimum required system components

- What are the minimum required components in an LLLC system?
  - Fixture-integrated controllers (to switch ON/OFF; dim up and down; connect to the network)
  - Fixture-integrated occupancy sensors and photosensors
  - Switches (most spaces in code-compliant projects need a switch <or dimmer switch>)
  - Network – networks may be:
    - Wired … *or* …
    - Wireless … if you use a wireless LLLC system, then you will also need a wireless gateway(s). Gateways are not necessarily required for wired system. Some systems can work without gateways or servers.
  - Apps or software – to commission, program, zone and operate the system

Controllers 101

- Many people call controllers “power packs”. **Don’t do that!** Power packs are devices that have 1.) relays and 2.) transformers. They are typically used for things like powering and connecting to occupancy sensors to turn lights ON and OFF.
- **Controllers in NLC systems typically have:**
  - Relays – to turn lights ON and OFF
  - Dimming outputs – typically 0-10V (but they can use other protocols such as DALI or proprietary)
  - Network connection – this can be either:
    - Wired – in which case there will be an Ethernet or other kind of port for the wire/conductors
    - Wireless – in which case there will be 1.) a radio, and 2.) an antenna
  - Some controllers have other things as well, such as ports for sensor inputs (especially if they are designed for use in LLLC systems).

Fixture-integrated sensors

Apps/software

Load Controllers | Hub | Apps | Software | Wall Contr

Vive Vue
Building management & analytics

Enterprise Vue
Enterprise Level building management & analytics

QuEst-D
Free Web-based Quick Estimation Tool

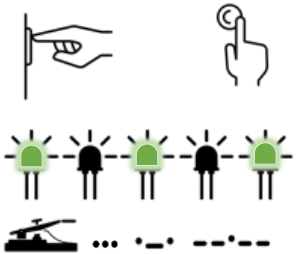
Vive Designer+
Design Software

Vive Hub Firmware

These are examples of software that provide additional functionality beyond the native app in the “hub” (server/gateway)

Different user interfaces/methods of commissioning

Push n' Program

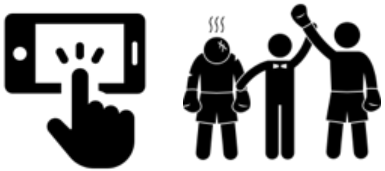


Remote Control

Totally Remote

Desktop / Web Applications

App-Based



Courtesy of John Arthur Wilson

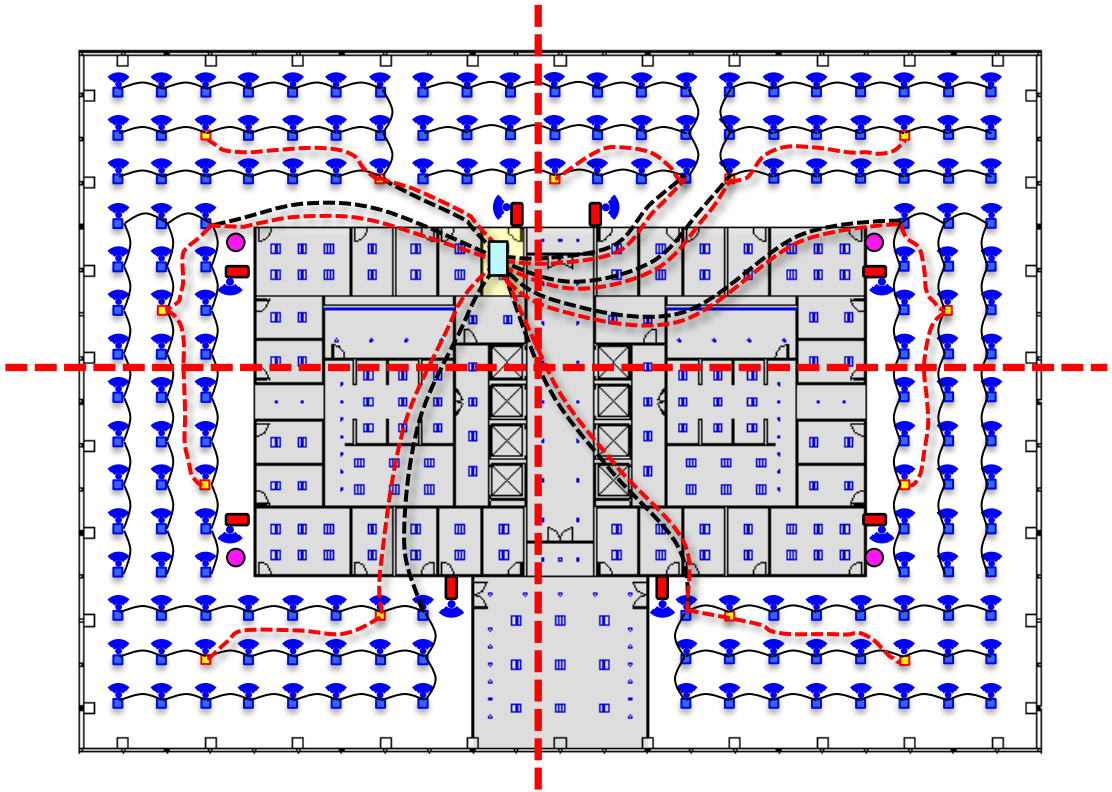
Lighting Control
System Topologies

Wireless LLLC system (w/fixture-integrated sensors)

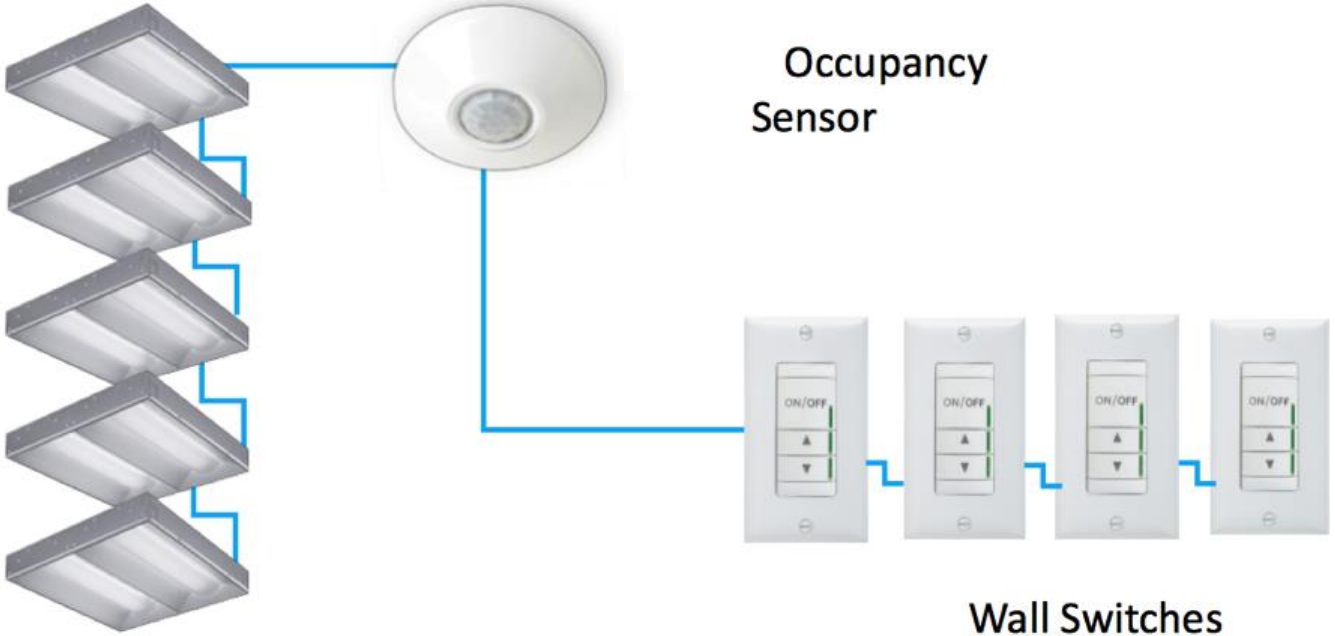
Wireless LLLC system (w/fixture-integrated sensors)

LEGEND:

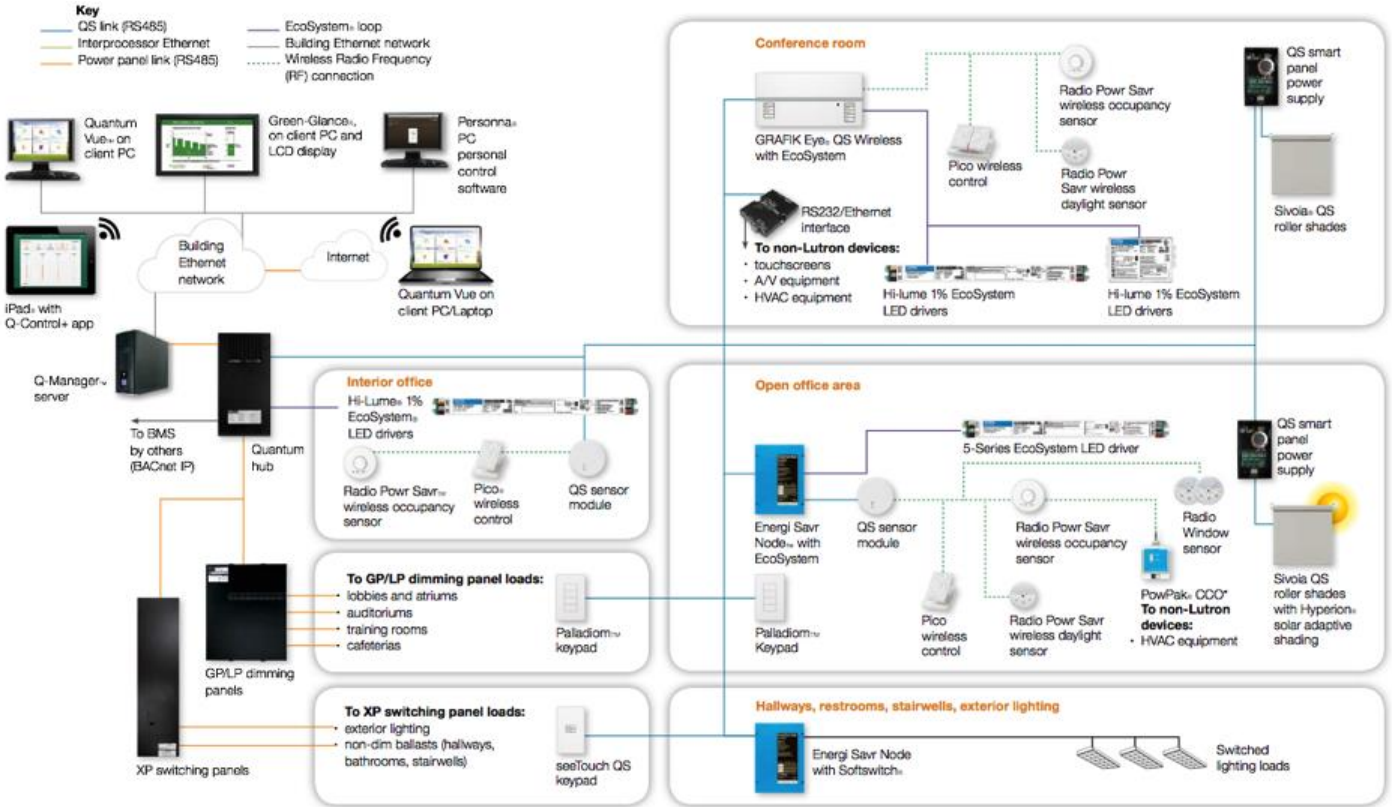
- Existing circuit breaker panel
- 2x2 fixture (normal power) with wireless controller, integrated occupancy sensor and photosensor
- EM fixture (integral battery) with wireless controller, integrated occupancy sensor and photosensor
- Wireless gateway
- Wireless wallbox switch/dimmer
- Home-run to panel
- Branch circuit (power wires)
- Constant-charging circuit (unswitched)



Wired LLLC system (w/fixture-integrated sensors)



Wired DALI system



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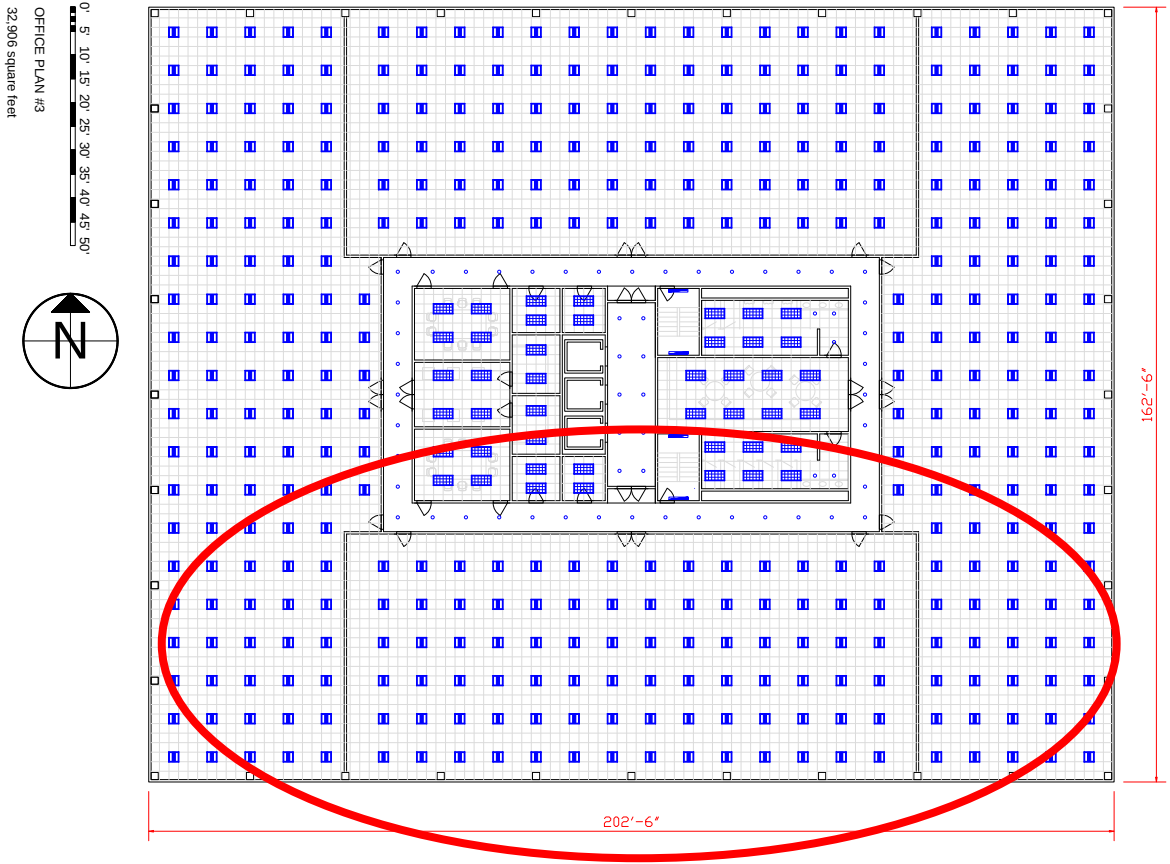
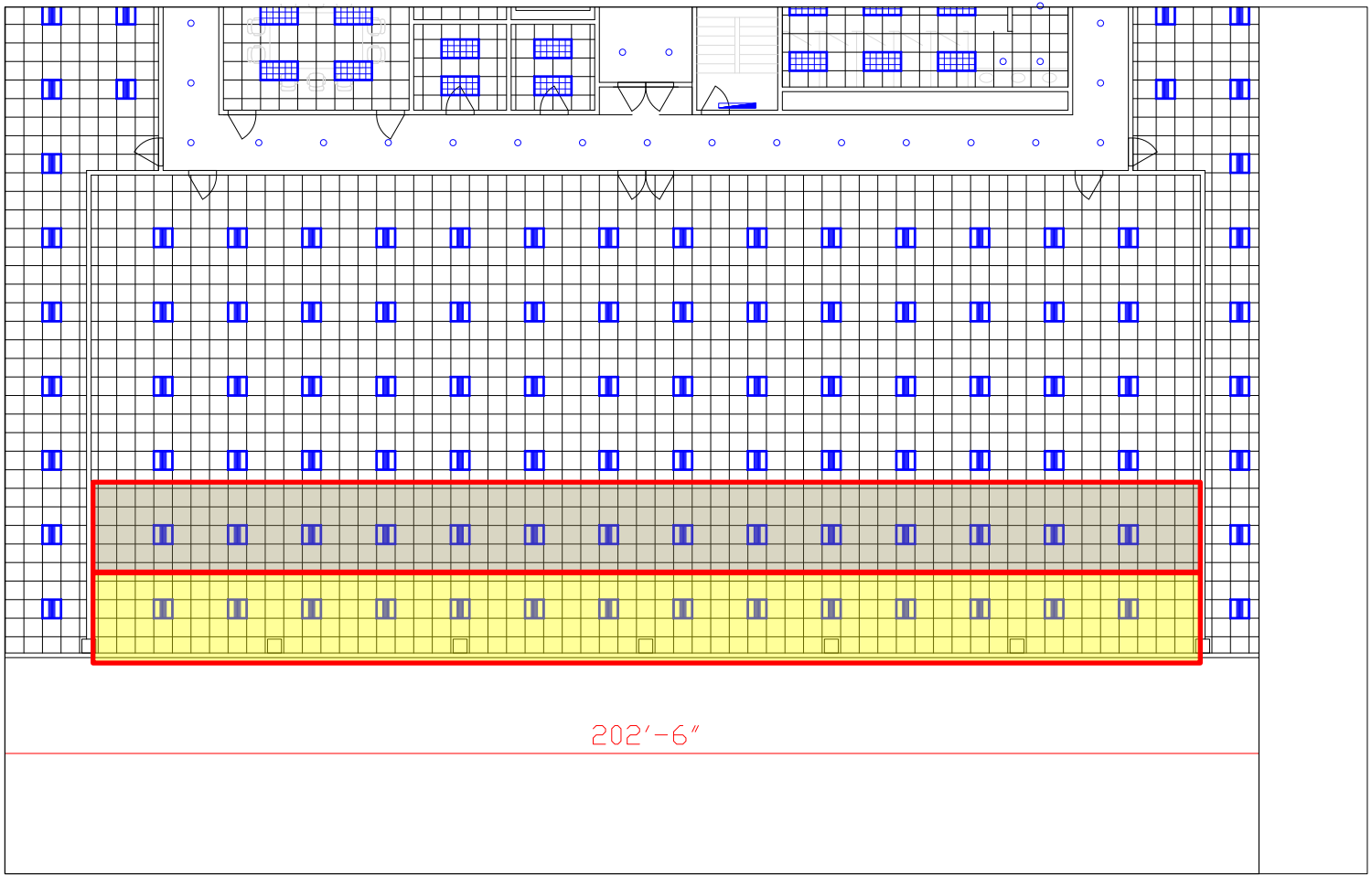
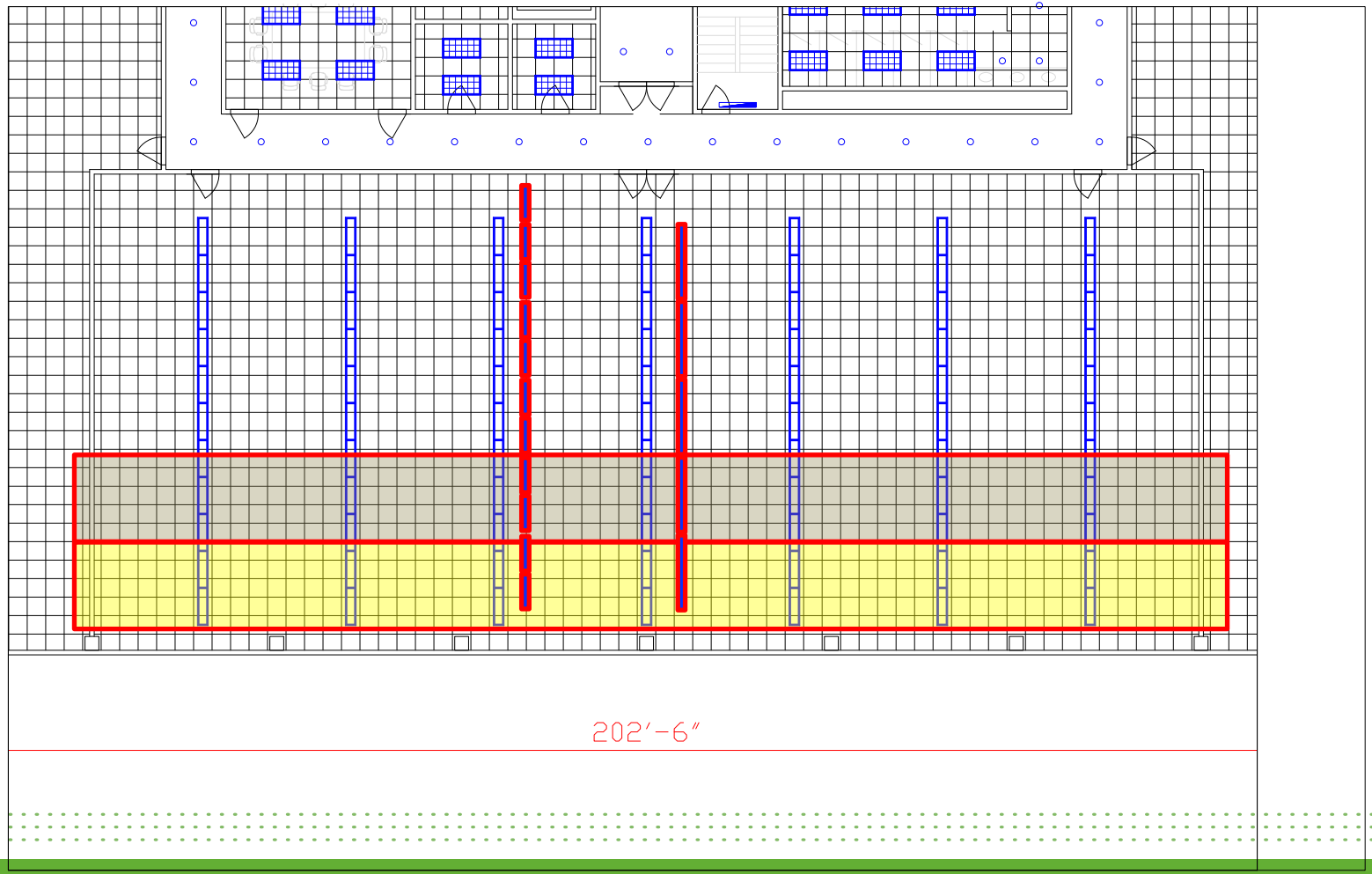
Configuring NLC/LLLC systems with fixture layouts


OFFICE PLAN #3
32,906 square feet
0' 5' 10' 15' 20' 25' 30' 35' 40' 45' 50'
N
162'-6"
202'-6"

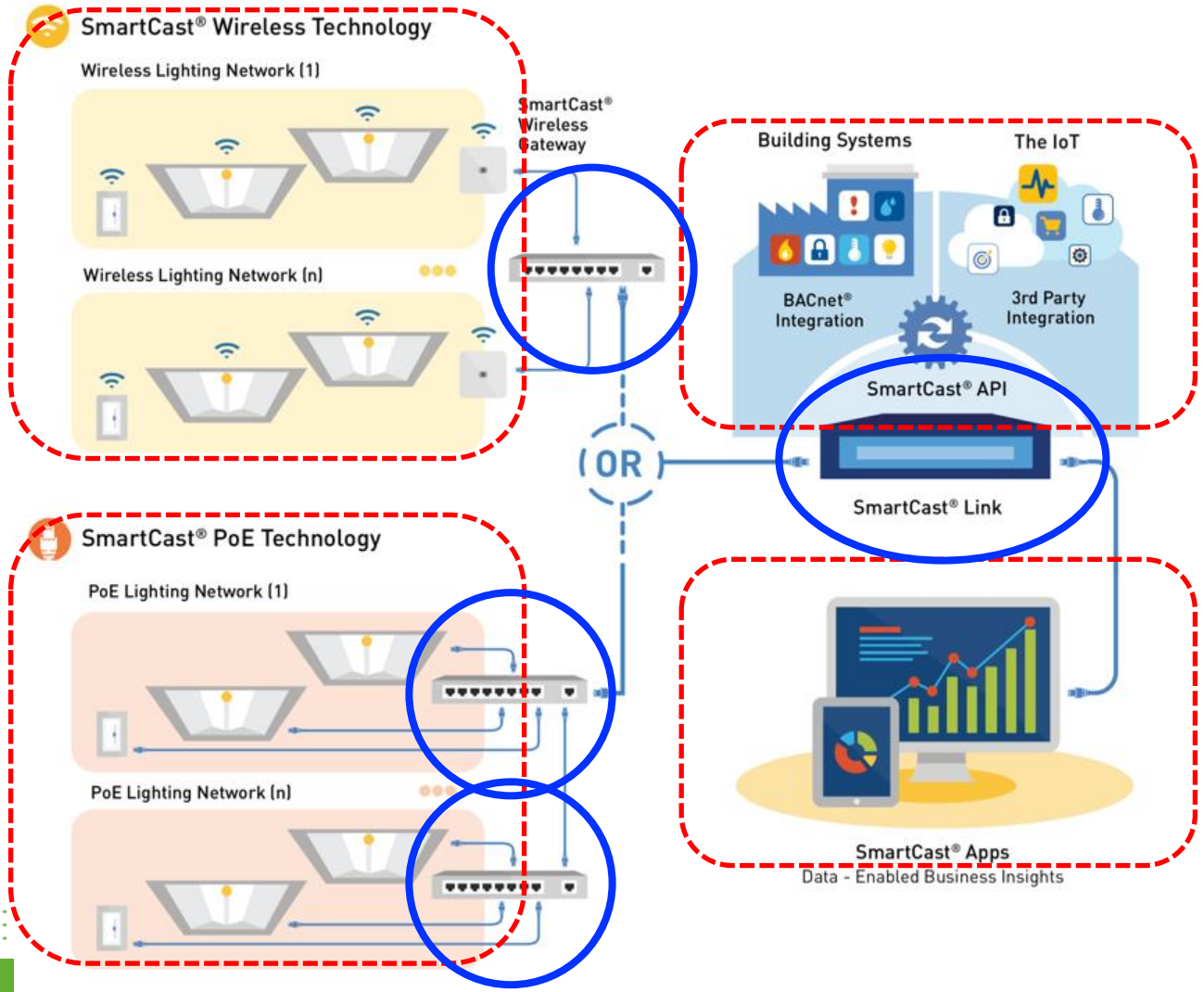

202'-6"


202'-6"

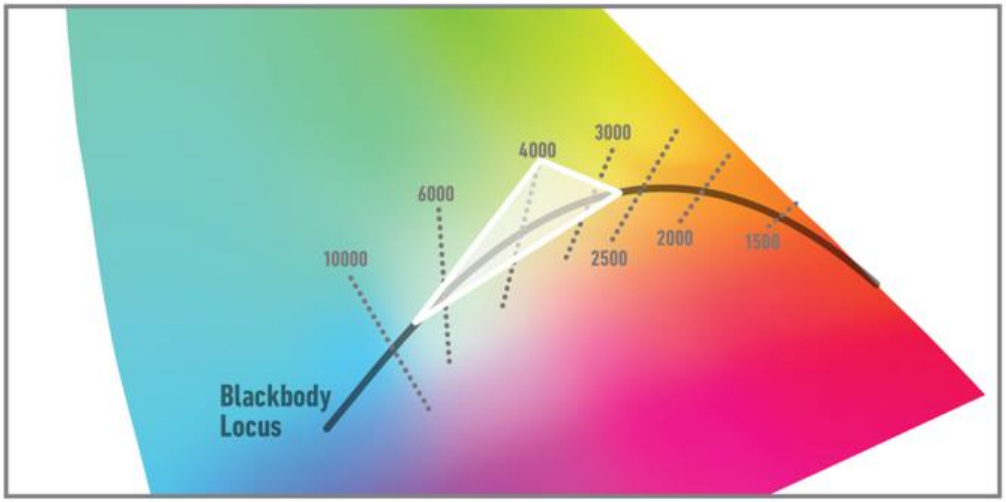
Ameren
ILLINOIS
Topics and activities for in-person classes

Additional topics for in-person classes

1. COVID mitigation strategies using NLCs
2. IoT (Internet of Things)
3. Color-changing (RGB)/tunable-white (warm-cool)
4. Hands-on activities:
    1. Attendees will commission a wireless LLLC/NLC system
    2. Attendees will commission a Bluetooth LLLC system


SmartCast® Wireless Technology
Wireless Lighting Network (1)
SmartCast® Wireless Gateway
Wireless Lighting Network (n)
Building Systems
The IoT
BACnet® Integration
3rd Party Integration
SmartCast® API
OR
SmartCast® Link
SmartCast® PoE Technology
PoE Lighting Network (1)
PoE Lighting Network (n)
SmartCast® Apps
Data - Enabled Business Insights

Wattstopper tunable-white with 3 primaries



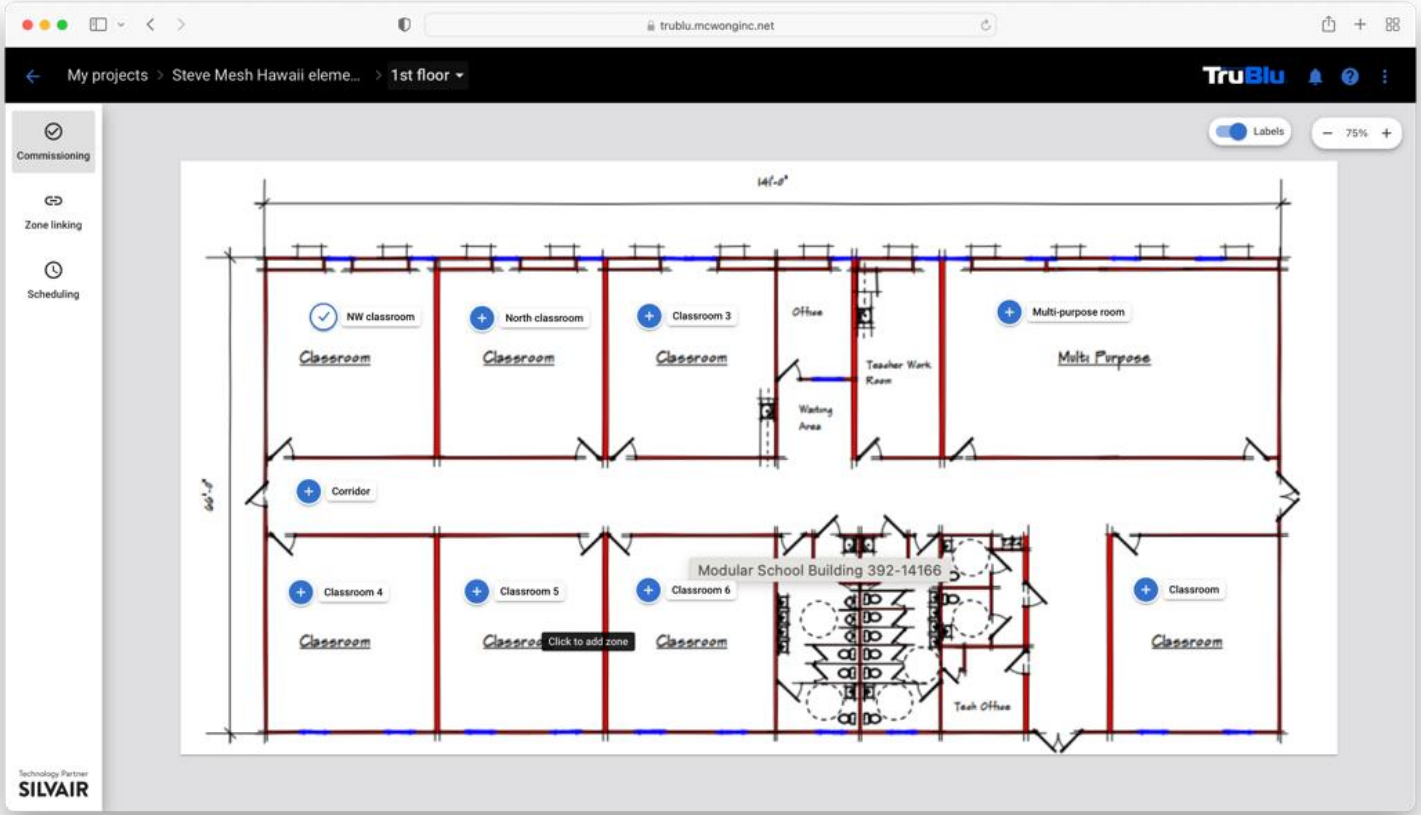
Blanco 3

Three white LEDs
(2700K – 6500K)

Tunable range is within the white shaded gamut.

Image courtesy of WattStopper

Commissioning a Bluetooth system



Thank You to:

Ameren Illinois Energy Efficiency Program

Resource Innovations

Instructor information

Steven Mesh, LC, IESNA
1009 Kapiolani Blvd., #2808
Honolulu, HI 96814

415-516-8126
steve@stevemesh.com

Next Power Lunch:

DOE Better Plants

Wednesday, July 14th

Energy Efficiency
PROGRAM

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