

## Designers Lighting Forum

### **Introduction to Building Automation Integration**

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



## Learning Objectives

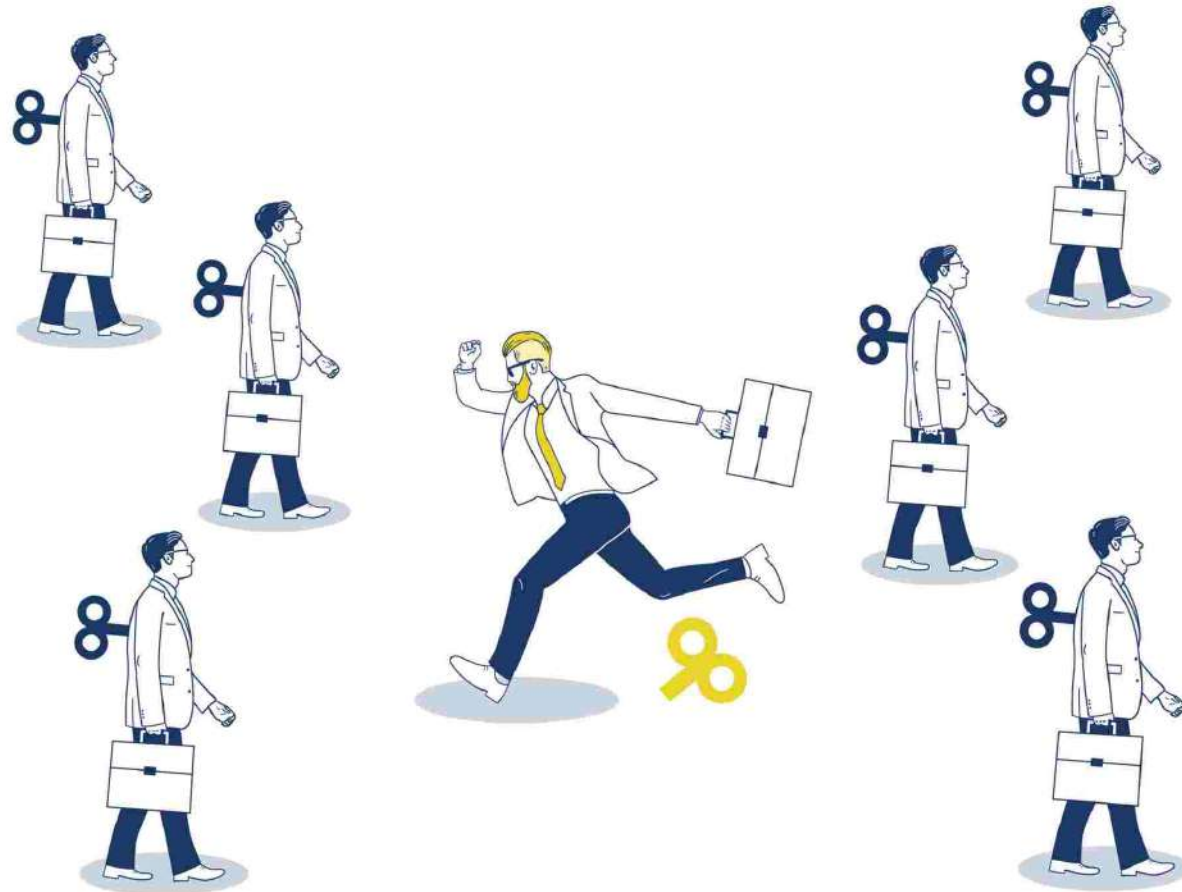
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At the end of this course, participants will be able to:

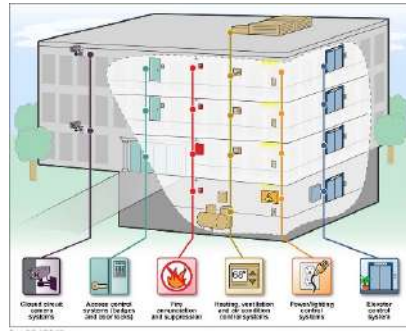
- 1. Engage with clients about integration and BAS needs**
- 2. Discover the need for a BAS and integration on a project**
- 3. Coordinate a lighting controls system that integrates with a BAS**
- 4. Better specify for projects that use a BAS integrator**



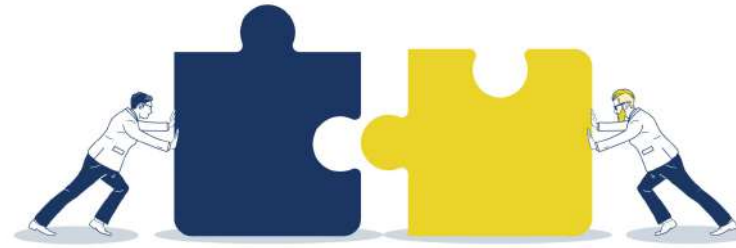
## Building Automation Integration: What You Need to Know



# Presentation Roadmap



**Section 1**  
**What is Building Automation?**



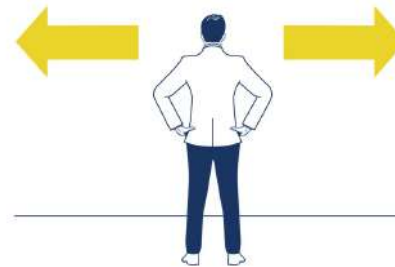
**Section 2**  
**The Building Blocks of Building Automation**



**Section 3**  
**System Overview**



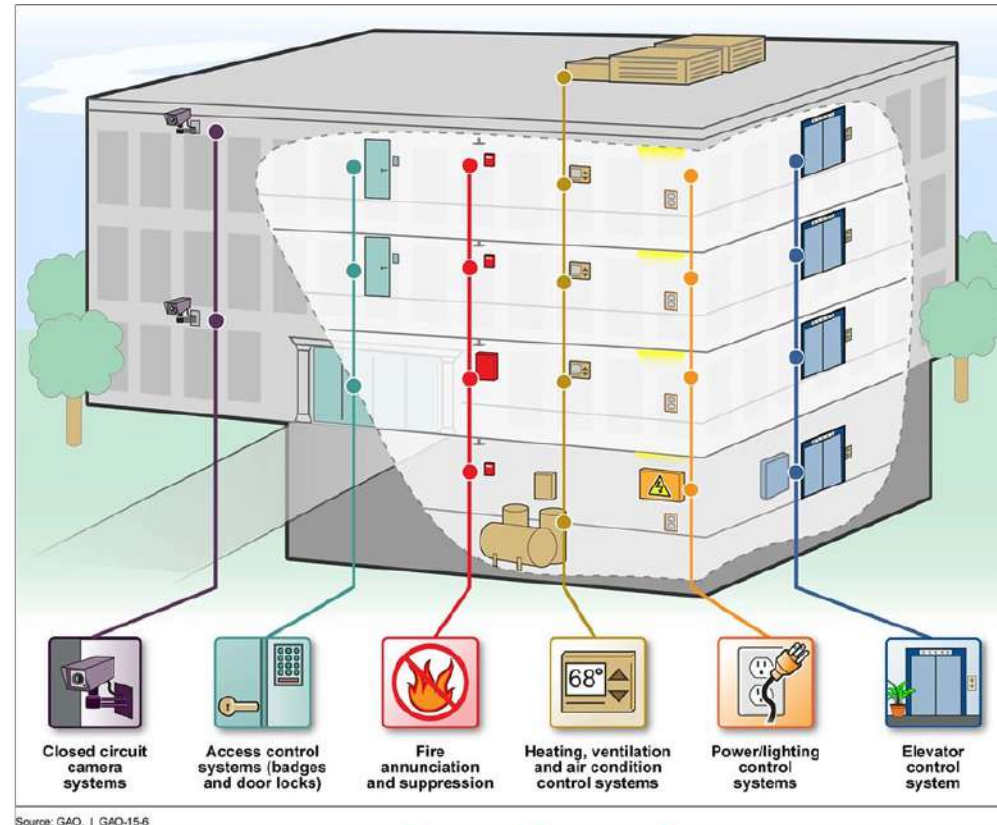
**Section 4**  
**Design Overview**



**Section 5**  
**Case Studies**



**Section 6**  
**How to Coordinate and Future Proof**



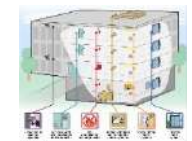
## Section 1

# What is Building Automation?

# Think of BAS as a Smartphone



Central Controller



# Think of BAS as a Smartphone



Central Controller



AV System





# Think of BAS as a Smartphone



Central Controller



AV System



Security



# Think of BAS as a Smartphone



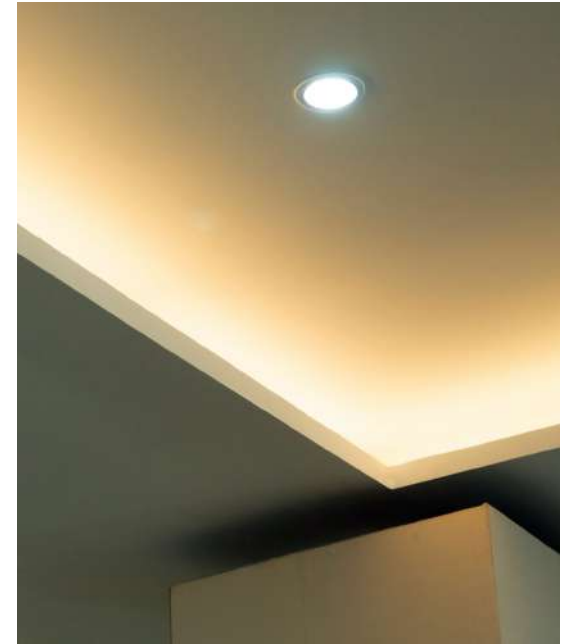
Central Controller



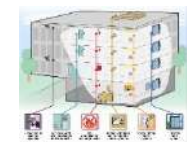
AV System



Security



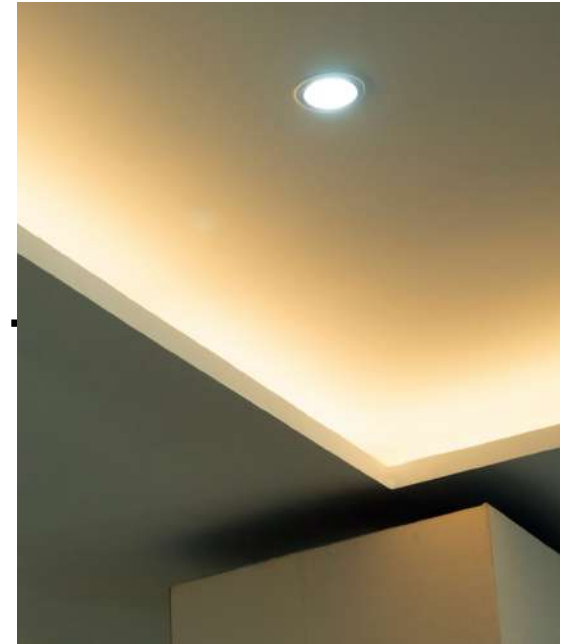
Lighting



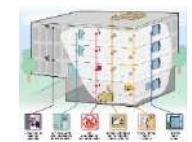
# Think of BAS as a Smartphone



Central Controller



Lighting

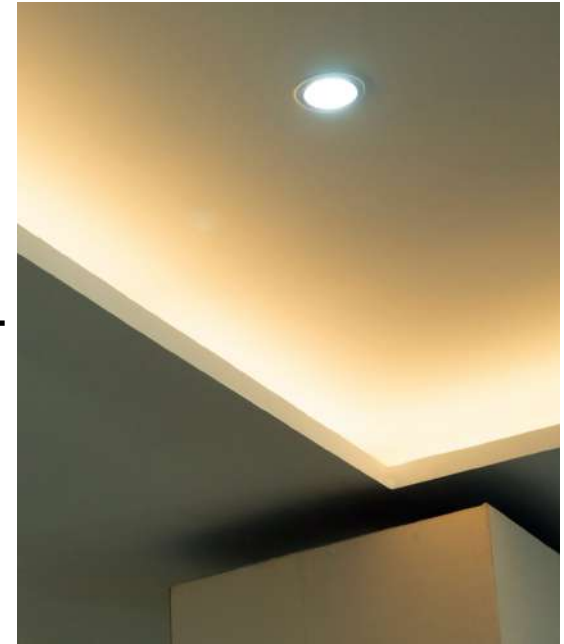


# Think of BAS as a Smartphone

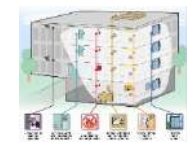


Central Controller

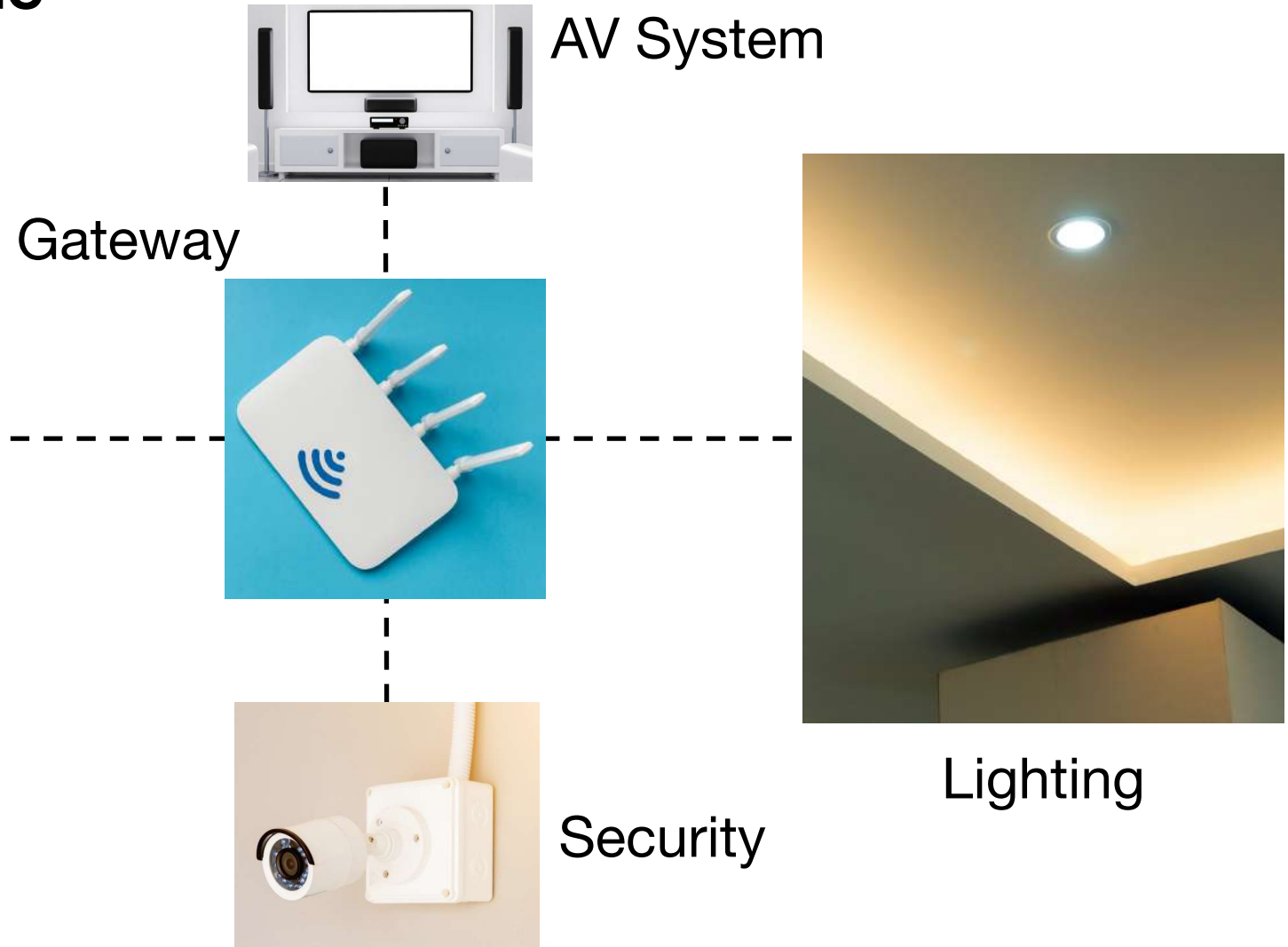
Gateway



Lighting



# Think of BAS as a Smartphone

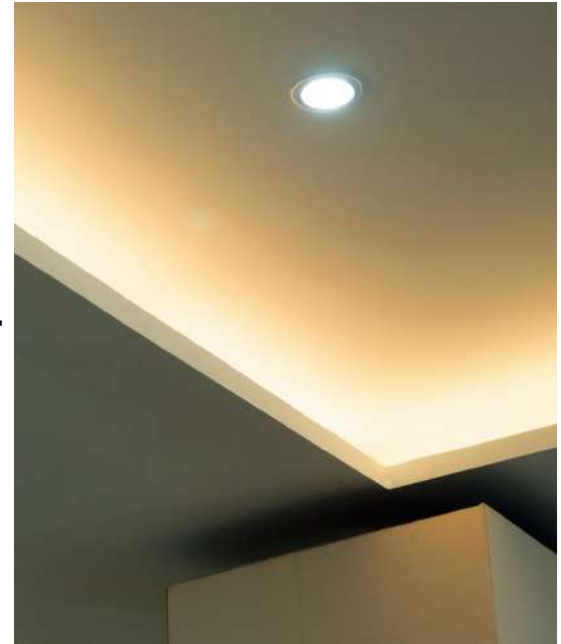


AV System

Gateway



Security



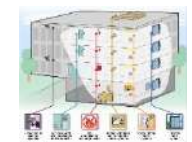
Lighting

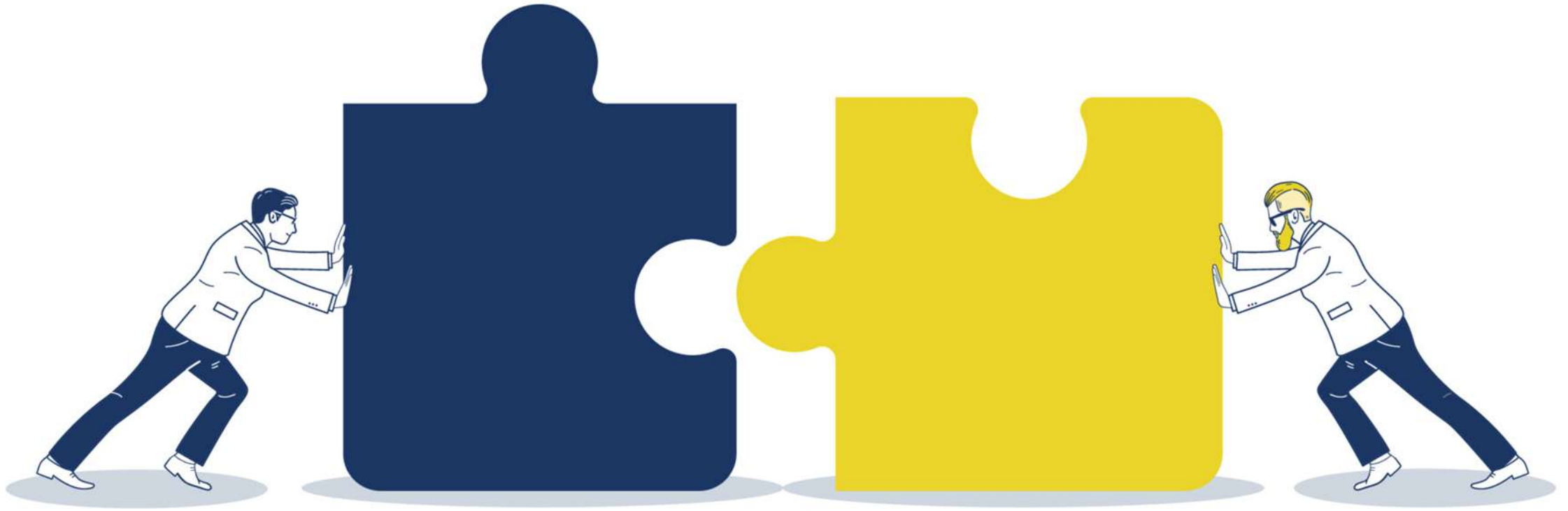


# Think of BAS as a Smartphone



- Brands can be important to success
- Sales agents are a necessary resource
- “Packaging” projects can be ideal for sales, not necessarily for project success





## Section 2

# The Building Blocks of Building Automation

# Scenario



Sofia is a lighting designer who needs to provide:

- Lighting design
- Controls design
- Integration design
- Building Automation System (BAS) design





# Roles and Responsibilities – New Construction

## Design Team

- Owner
- Architect
- Electrical Engineer / DB GC
- Mechanical Engineer / DB GC
- Lighting Designer
- Lighting Controls Designer
- Manufacturer's Representative\*
- Integrator\*

\* Additional considerations required

## Construction Team

- General Contractor
- Electrical Contractor
- Mechanical Contractor
- Manufacturer's Representative\*
- Integrator\*



# Roles and Responsibilities

## Building Automation Designer

- Electrical Engineer / DB GC
- Mechanical Engineer / DB GC
- Lighting Designer
- Lighting Controls Designer
- Manufacturer's Representative\*
- Integrator\*

\* [Additional considerations required](#)

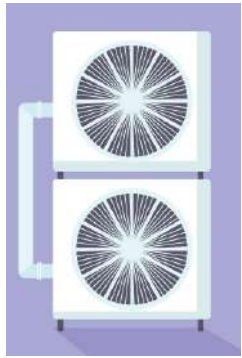
## Building Automation Installer

- General Contractor
- Electrical Contractor
- Mechanical Contractor
- Manufacturer's Representative\*
- Integrator\*



# Where Does BAS Belong?

Mechanical, Automation, Electrical?



Division 23 - HVAC

Division 25 – Integrated Automation

Division 26 – Electrical

Division 27 - Communications



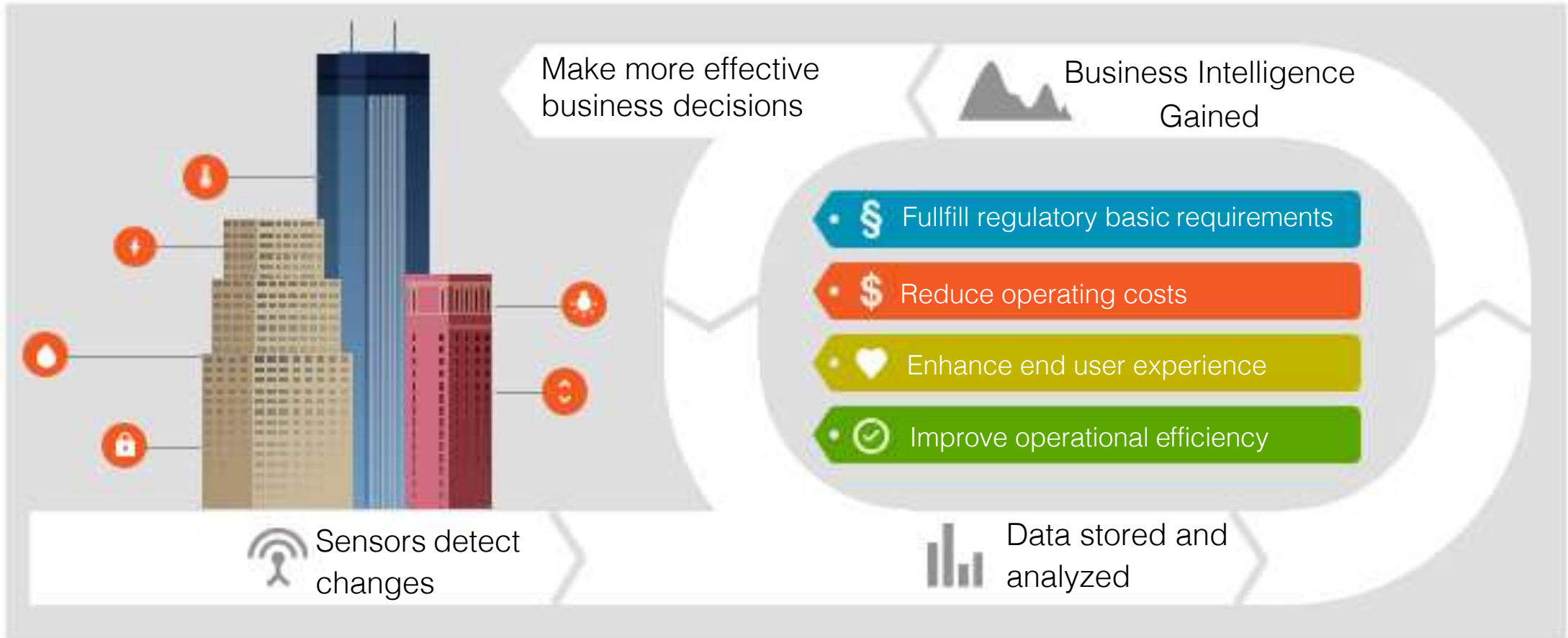
- Should not be based on BAS designer.
- Should be based on BAS contractor / integrator.
- Always provide a well coordinated written and drawn specification.
- Provide a scope matrix to ensure proper coordination.



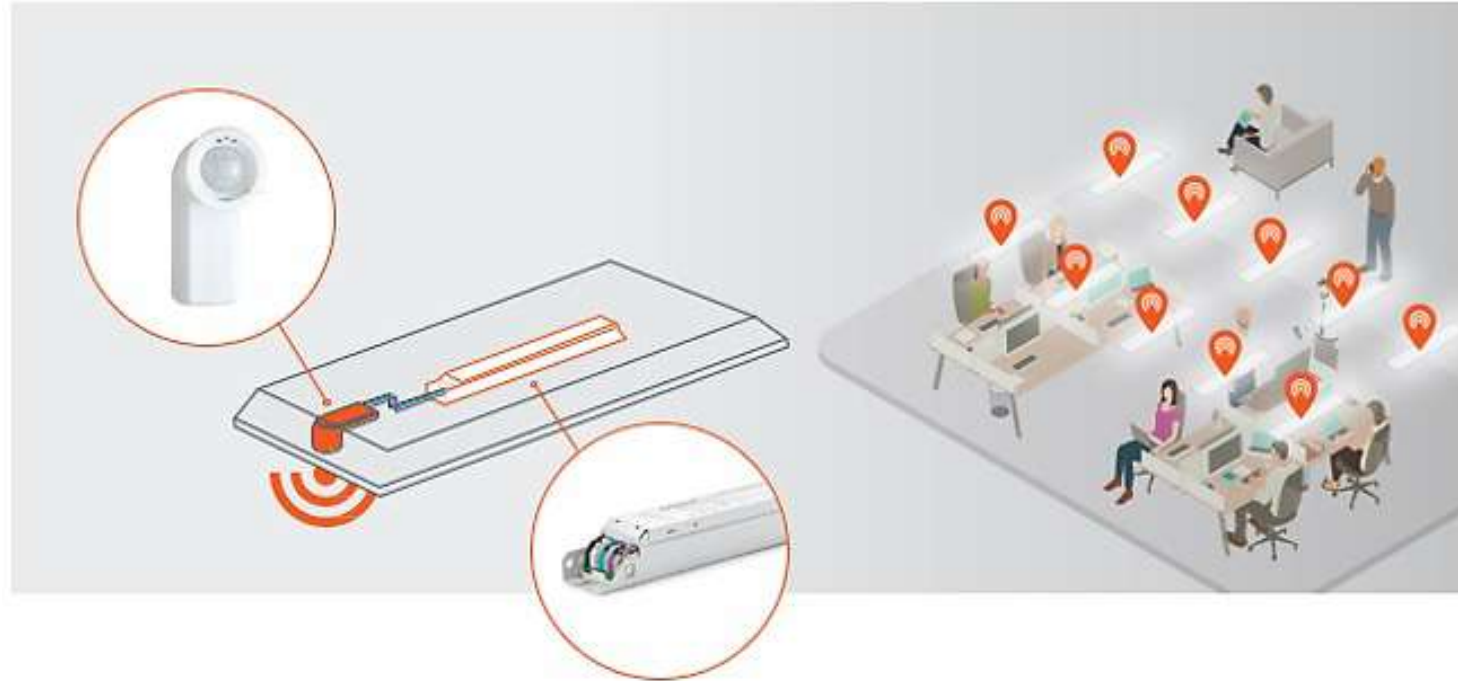


## Section 3 System Overview

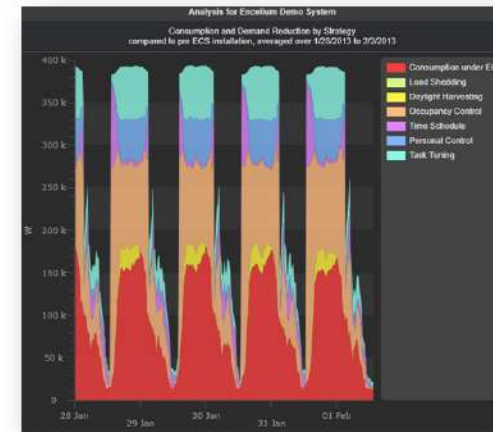
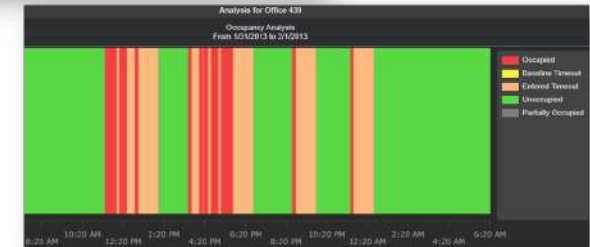
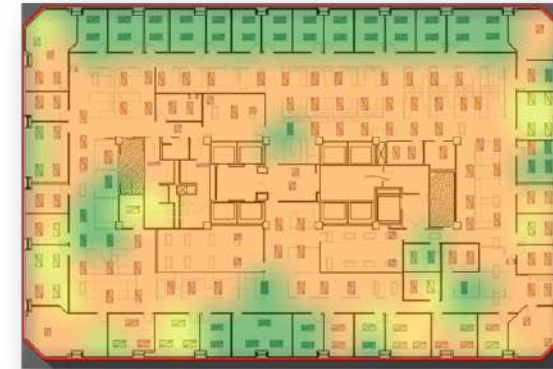
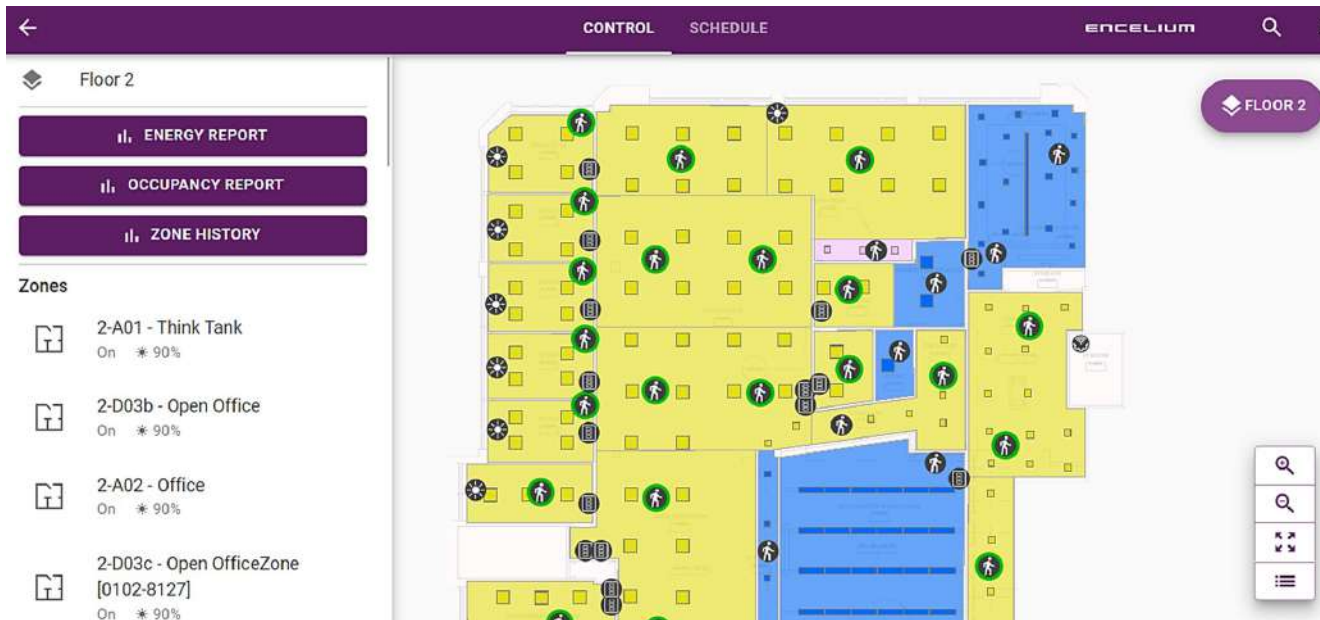
# Why Do This?



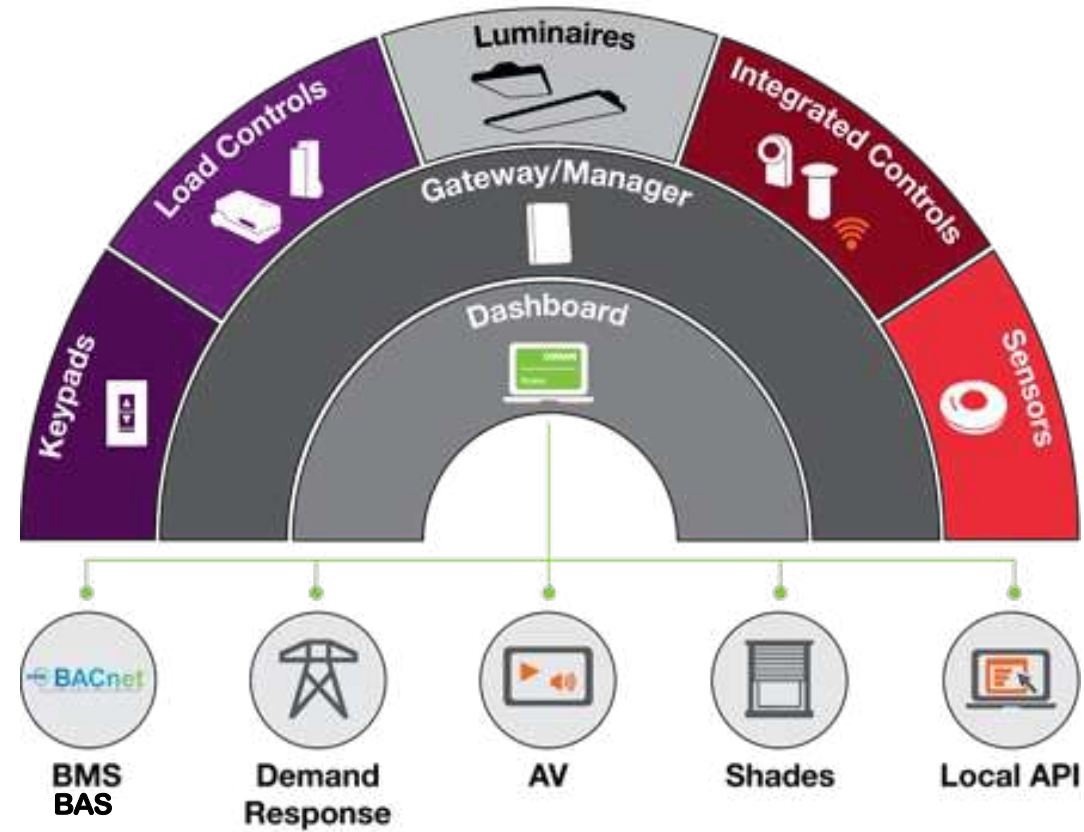
# Lighting “the digital ceiling”



# System Overview - Data

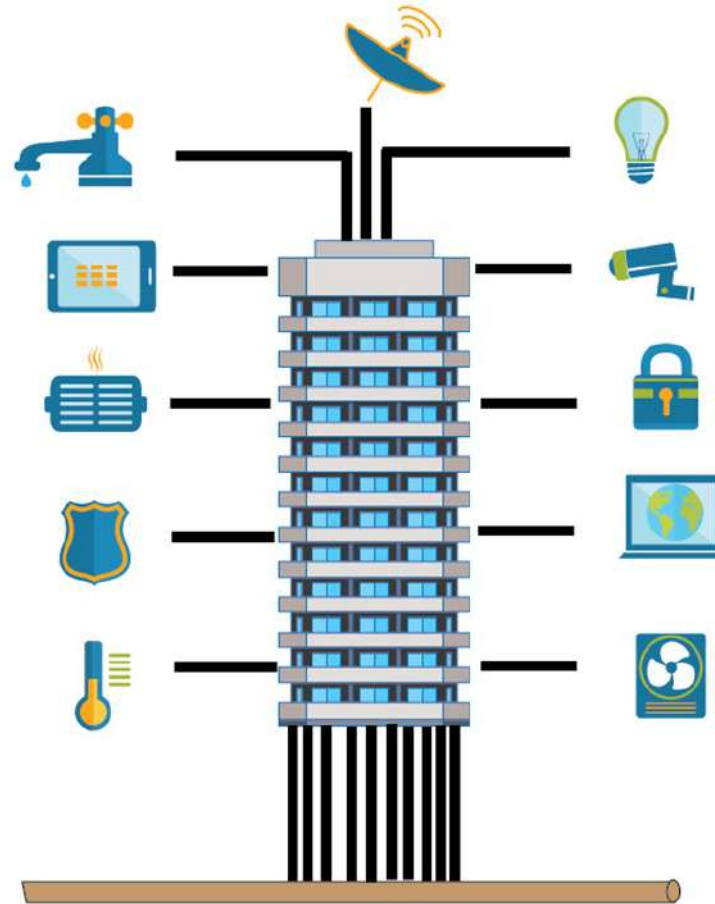


# System Overview – System Architecture





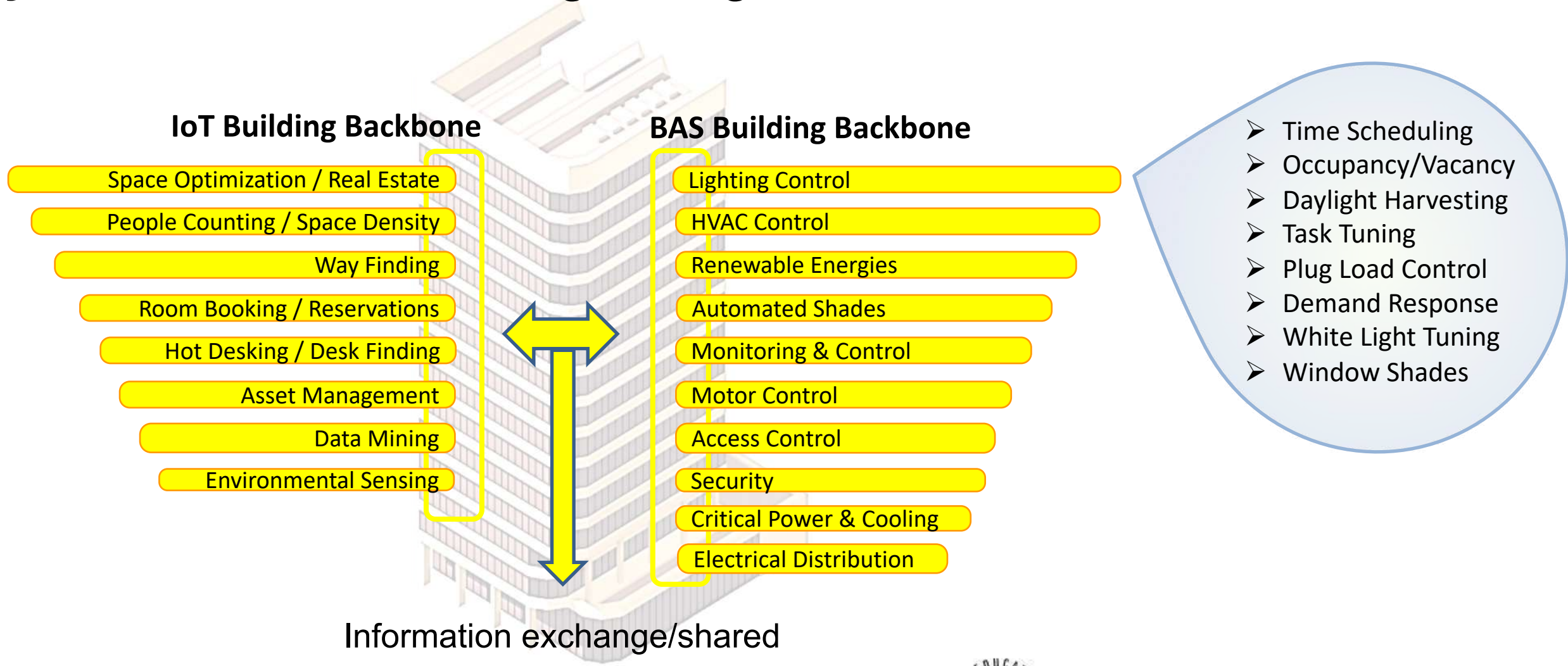
# System Overview – System Architecture



Coordinated Monitoring & Control

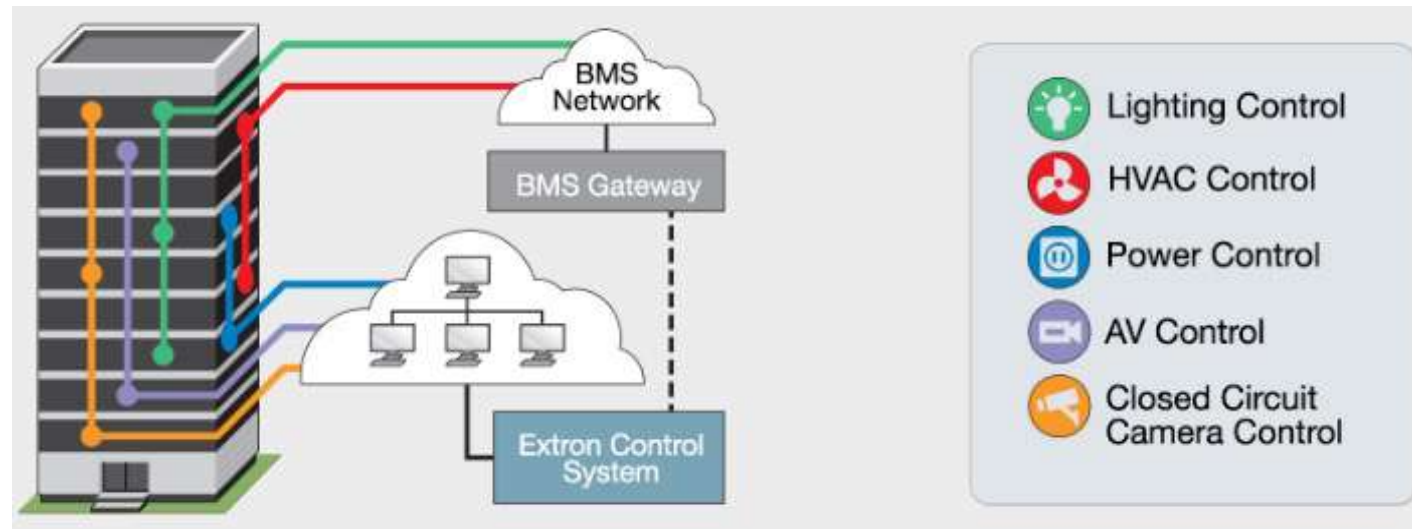


# System Overview – Sharing intelligence



# BACnet Systems – What is BACnet?

- An open industry standard communication protocol for **Building Automation and Control networks** that leverage the ASHRAE, ANSI and ISO standard protocol.
- Widely used industry protocol designed to allow communication (monitor & control) of building automation and control systems for applications
- !! Does not replace a sub systems individual operating protocol (OS settings, DLHV)



# BACnet Systems and Lighting

- A data communication protocol is a set of rules governing the exchange of data over a computer network that covers everything from what kind of cable to use to how to form a particular request or command in a standard way.

Property	BACnet Type	Description
Light Zone State	Binary Value*	State of the defined lighting zone – ON or OFF
Light Zone Dimming	Analog Value*	Light output level of the defined lighting zone, from 100% (maximum light output) to 0% (minimum light output)
Fire Alarm State	Binary Input	State of the fire alarm system – alarm activated or alarm not activated
Occupancy State	Binary Output	State of the defined occupancy sensor – occupancy detected or not detected
Photo Sensor Daylight Readings	Analog Output	Reports daylight readings by photosensors
Sheddable Load	Analog Output	Reports the total lighting load available for load reduction according to the ENCELIUM EXTEND LMS, defined in watts
Shed Status	Analog Output	Reports the total current load reduction achieved according to ENCELIUM EXTEND LMS defined prioritization, defined in watts
Shed Request	Analog Input	Requested total amount of load reduction, defined in watts or as a percentage of sheddable load
Sheddable Load (Group)	Analog Output	(As above, unprioritized for the selected group)
Shed Status (Group)	Analog Output	(As above, unprioritized for the selected group)
Shed Request (Group)	Analog Input	(As above, unprioritized for the selected group)
Load Shedding Total Demand	Analog Output	Reports the total lighting demand of all devices in a load shedding group (in Watts).
Schedules	Schedule	A periodic schedule that may recur during a range of dates, with optional exceptions at arbitrary times on arbitrary dates

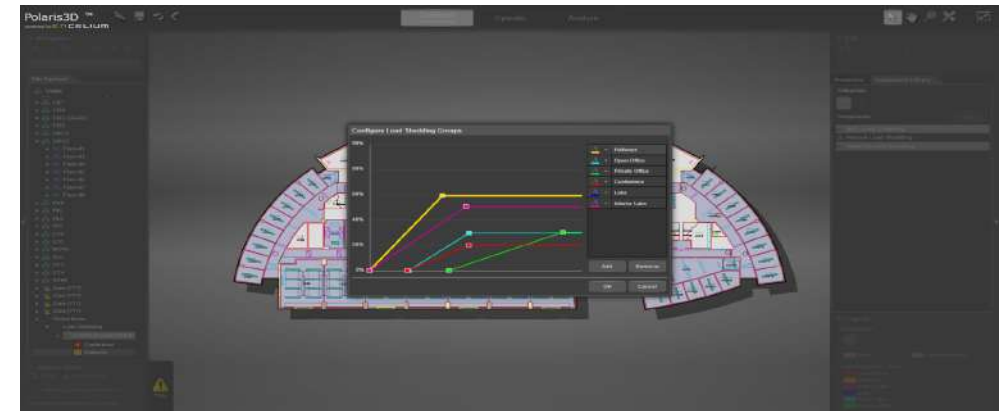


BTL Mark represents a high level of quality and conformance based on independent testing



# Application Example

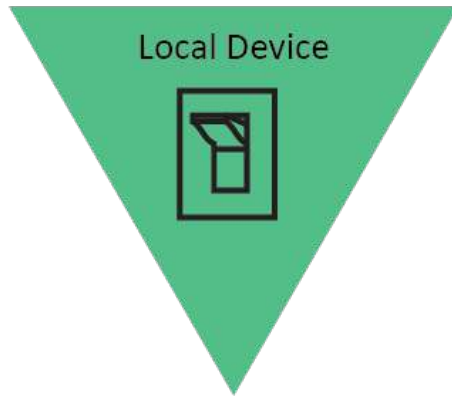
- Set back HVAC set point when spaces unoccupied
- Reduce Energy Consumption by 25% in year 1
- Reduce Energy another 10% in year 2
- Enable automatic lighting reductions on curtailment





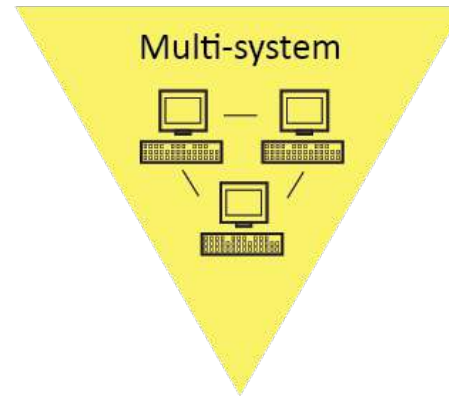
## Section 4 Design Overview

# Types of Integrations



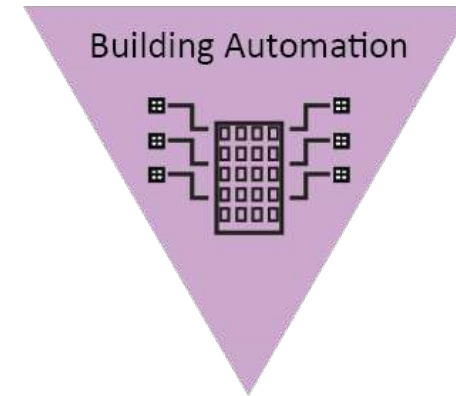
## Local Device Integration

- Device to Device
- Simple Software
- Plug Load Control
- Shade Control



## Multi-System Integration

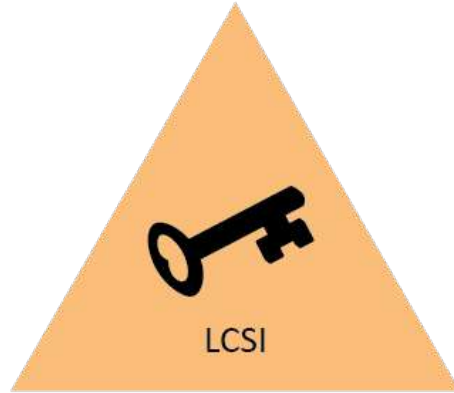
- Existing Lighting Systems
- Audio/Visual
- Conference Rooms
- HVAC
- Fire Alarm
- Various Software



## Building Automation System (BAS) Integration

- Holistic Building-wide
- IoT
- Complex Software
- Deeper Data Mining

# Types of Integrators



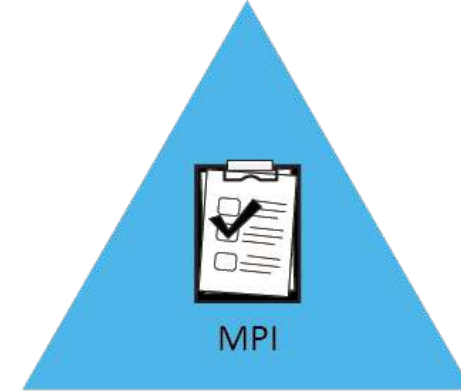
## Lighting Control Systems Integrator

- Third-party Contractor
- Different Protocols
- Local
- Multi-Systems
- Building Automation



## Multi-Systems Integration Consultant

- Consultant
- Open or Proprietary Protocols
- DMX and Color Changing
- Multi-Systems
- Building Automation



## Manufacturer Provided Integrator

- Service Technician
- Proprietary Protocols
- Systems by Manufacturer Only





# Specification Examples

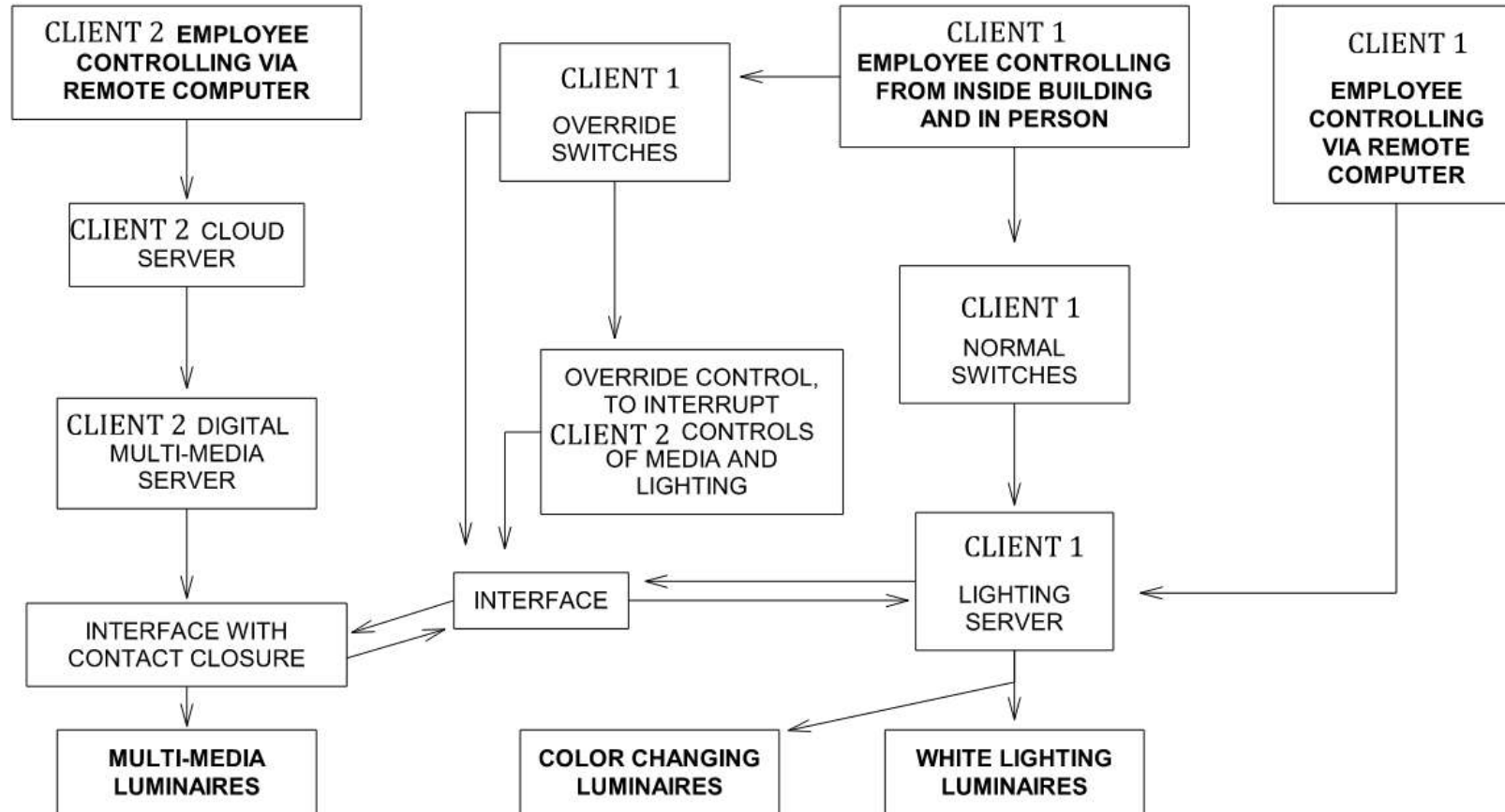
## Control Intent Narrative

### CONTROLS AND PERFORMANCE

1. Owner custom web application:
  - A. Owner's custom web application controls the building automation system and lighting controls via remote computers connected to the internet.
  - B. Controls for individual spaces:
    - i. Luminaire zone intensity.
    - ii. Room temperature.

# Specification Examples

## Sequence of Operations



# Specification Examples

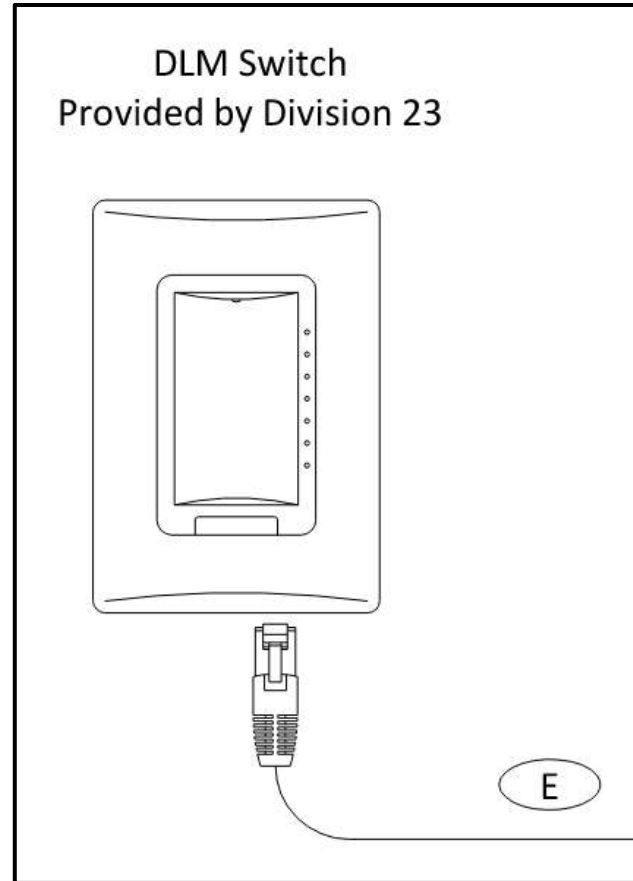
## Scope Matrix

ELECTRICAL CONTRACTOR	DIVISION 23 CONTRACTOR
<ul style="list-style-type: none"><li>• INSTALLATION OF ALL DEVICES AND PRE-FABRICATED CABLES REQUIRED FOR A COMPLETE AND FUNCTIONAL SYSTEM AS SPECIFIED HEREIN.</li><li>• LINE VOLTAGE HARDWARE, DEVICES, AND TERMINATIONS.</li><li>• ALL WIRE LABELLING AND CONTINUITY.</li><li>• LUMINAIRE CONNECTION AND PROGRAMMING.</li></ul>	<ul style="list-style-type: none"><li>• LOW VOLTAGE WIRE AND TERMINATIONS.</li><li>• LIGHTING CONTROL SYSTEM STARTUP.</li><li>• LIGHTING CONTROL SYSTEM INTEGRATION WITH BAS.</li><li>• LIGHTING CONTROL COMMISSIONING.</li><li>• LIGHTING CONTROL PRESET PROGRAMMING.</li><li>• BAS STARTUP.</li></ul>



# Specification Examples

## One-Line Diagram



# Specification Examples

## Written Specifications

ELECTRICAL SYSTEMS INTEGRATION SECTION 28 05 45.13	
PART 1 GENERAL	
1.1	RELATED DOCUMENTS
A.	26 51 13 – Architectural Lighting Fixtures, Lamps, Ballasts
B.	26 09 23 – Lighting Control Devices
1.2	SUMMARY

3.2	EXECUTION
A.	Retain a Lighting Control Systems Integrator as specified in Section 28 05 45.13.
B.	Provide documentation of the final settings established for all lighting controls as dictated by Lighting Control Systems Integrator and included in the O&M manual.

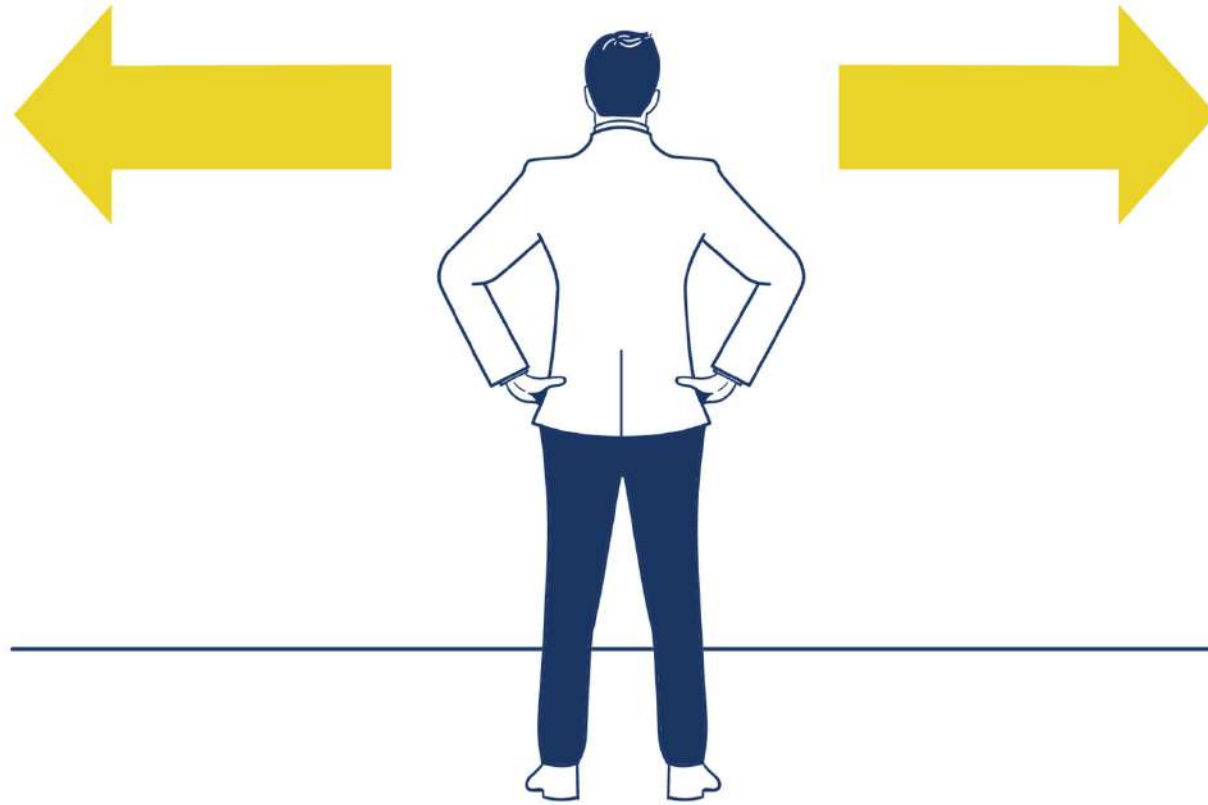
# Scenario Breakdown



Sofia needs to:

- Identify integrations
- Specify integrators and responsibilities
- Coordinate
- Building Automation System (BAS) design





## Section 5 Case Studies

# “Ideal World” Brief



- OPR - Owner clearly states building functionality
  - How: lighting, cameras, security, climate enhance the occupant experience
- Prior to bid, the EE gathers the disciplines to review operational intent and written spec integrity
- The CD's provide a clear narrative and SoO are shown in DIV 25 and DIV 26
- Each discipline bids their respective system/services
- System integrator provides services that meet the OPR





# “Ideal World” Brief



- Lack of owner input regarding functionality
  - Guess work setting up system settings, unhappy occupants
- Specs are vague and do not provide clear intent
- No spec narrative and SoO may be missing or generic
- Each discipline bids without allowing for additional integration work
- Systems may not work as desired or take full advantage of the integration



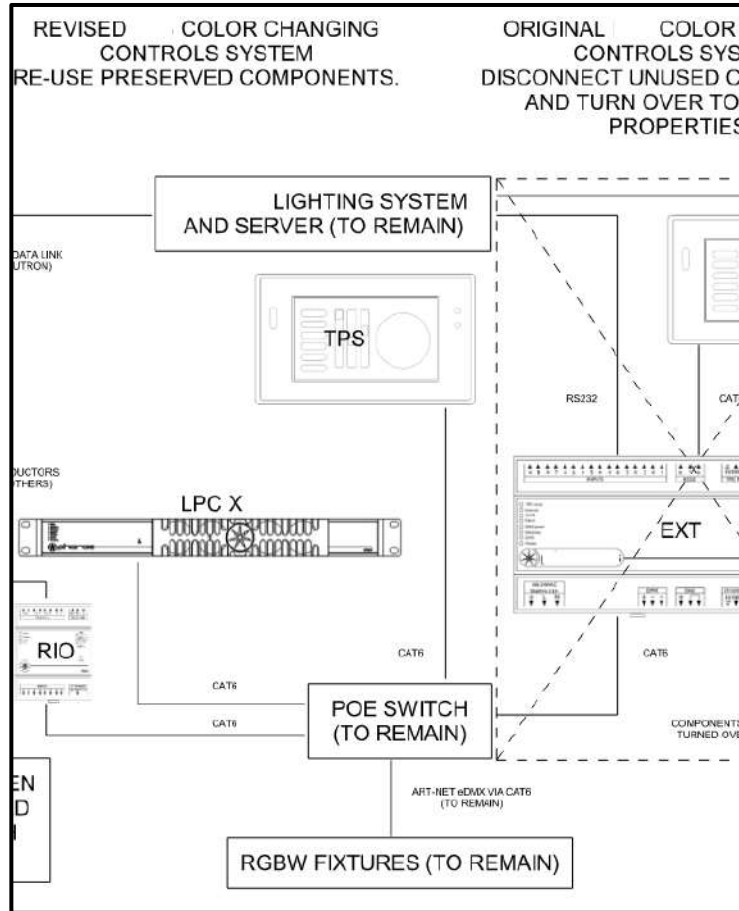
# Poor Integration



- “By Others” used
- Incomplete systems
- Missing devices
- Incomplete commissioning



# Poor Integration – How to Fix It



- Specify functionality of devices
- Provide complete and detailed DD's
- Show interactions between systems
- Identify existing and new equipment
- Show device elevations



# Unclear Intent Examples

- a) System **shall** be capable of integrating to the BAS via BACnet
- b) Lighting **shall** respond to an alarm signal from the BAS
- c) Lighting control system occupancy sensor shall connect to HVAC system via contact closure or BACnet
- d) Lighting control integration shall be provided by others



# Unclear Intent Examples – How to Fix It

- LCS shall be capable of integrating to the BAS via BACnet

Lighting Control System accepts commends from the HVAC, Fire, Security and Badging systems to trigger lighting events per the SoO

- LCS shall respond to an alarm signal from the BAS

In an alarm event, Lighting Control System takes lighting in all common spaces to 100% and holds until alarm is deactivated. All local LCS devices shall be locked during this period

- LCS occupancy sensor shall connect to HVAC system via contact closure or BACnet

Lighting Control System sends a command to the BAS when the space becomes unoccupied for 15 minutes. Temperature setback to 73F for an occupied state, 78F for unoccupied state

- Lighting control integration shall be provided by others.

Lighting Control System integrator specified in section 25 05 45.13 provides integration to connect Lighting Control System to building automation system



# Not Working? Then Bypass

- Often, FM's are tasked with managing many systems within their facility
- Initially, FM's tend to focus on systems that are problematic and causing the greatest occupant disruption
- When issues occur and FM's are not equipped to resolve the issue, they may opt to bypass a system and deal with it later.
  - Make people happy... and better get it done quickly mister
- In some cases, a system may not get back online

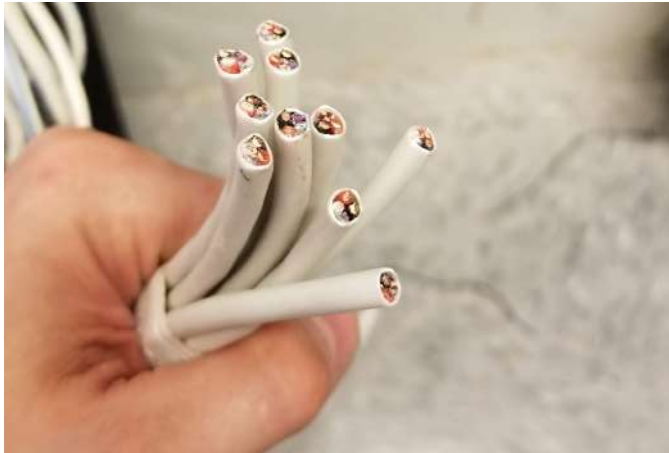


# Not Working? Then Bypass – How to Fix It

- Specifications can be written to help ensure the building staff receive support as part of the system deployment
- This may include:
  - Initial *Time spent early in the design can have a major impact on initial occupant satisfaction*
  - How to video *Time spent early in the design can have a major impact on initial occupant satisfaction*
  - Service agreement
  - Follow up training - Month 1, 2, 3
  - O&M Binder - Trouble Shooting steps
  - POC



# Inexperienced Labor



- Sloppy or incomplete installation
- Poor on-site coordination
- Mismanaged resources





# Inexperienced Labor –How to Fix It

ELECTRICAL SYSTEMS INTEGRATION  
SECTION 28 05 45.13

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. 26 51 13 – Architectural Lighting Fixtures, Lamps, Ballasts

B. 26 09 23 – Lighting Control Devices

1.2 SUMMARY

- Interview and identify integrators
- Require skilled integrators in specifications
- Specify responsibilities of integrators

## 3.2 EXECUTION

- A. Retain a Lighting Control Systems Integrator as specified in Section 28 05 45.13.
- B. Provide documentation of the final settings established for all lighting controls as dictated by Lighting Control Systems Integrator and included in the O&M manual.



# Forgot about the Emergency Lighting



- Lighting Designer and Electrical Engineer did not coordinate
- Added EM after design
- Required unattractive addition
- Dissatisfied owner



# Forgot about the Emergency Lighting – How to Fix It

- Coordinate emergency with responsible parties
- Plan out emergency in design
- Draw out sequence of operations with emergency
- Identify solutions before purchase





## Section 6

### How to Coordinate and Future Proof

# IoT System Integration - Narrative

- ✓ OPR
- ✓ Identify each system and relation to one another
- ✓ Operational intent
- ✓ SoO



# Commissioning – aka System Startup



“A systematic process that ensures that all elements of the lighting control system perform interactively and continuously according to documented design intent and the needs of the building owner.”

- *IES Lighting Handbook*



## A quality assurance process including:

- Reference to OPR / SoO
- Identify parties and responsibilities clearly in specs
- Activation, program, schedule, calibrate, M&V in the field to spec
- Performed by manufacturer, rep or contractor
- Ensures acceptance: Catch mistakes/reduce user push back



# Key Questions to Ask – Programming



- What is the BAS intent?
- What systems will be used?
- Who will program each system?
- Who will program the BAS?
- What protocol does each system use?
- Will multiple systems communicate?
- Will there be custom graphics?
- Will ongoing changes need to be supported?

# Key Questions to Ask – Training



- Who will maintain the space?
- How will the system be managed?
- What is this person's skill?
- How much time is required to train?
- Does the manufacturer need to support them after install?
- What happens if something goes wrong?
- Will the system need batteries to be replaced?





# Let's Review – Steps to Success



1. Define OPR
2. Identify various sub system types
3. Define each system attributes (as standalone)
4. Define system interaction/compatibility/protocols
5. IoT integration may be part of one sub system only?
6. Meet with disciplines - roles and responsibilities
7. Create detailed narrative(s) & SoO spec's
8. Create scope matrix
9. Create commissioning list
10. Execute training program



# Summary

- Maximize energy saving and occupant comfort with BAS integration
- OPR / Spec/Narrative – SoO / Installation / Commissioning / Training
- Ensure each sub system is commissioned correctly
- BAS integration is done once all sub systems are fully commissioned
- Training, training, training = end user satisfaction

# Thank you!

**Remember to complete  
your course evaluations.**



**Gary Meshberg**  
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**C. Webster Marsh**  
**[Webster@PenumbraControls.com](mailto:Webster@PenumbraControls.com)**

