



# Atlanta Chapter – IEEE Industry Applications Society

Presenter: Alan Wyant

January 22, 2013

# Agenda

---

welcome

- Market drivers
- Mechanically latched contactor control vs. controllable circuit breaker
- Integrated lighting control panelboard
- Stand-Alone for applications
- Networked system applications
- Control Strategies
- Web-enabled new and retrofit applications
- Customized color graphics
- Digital switches
- Wireless products
- Question & Answer Session

# Why Lighting Control

In the United States it is estimated that approximately one-quarter of the electricity budget is spent on lighting, or more than **\$37 billion annually**.

According to the New Buildings Institute, lighting controls can reduce lighting energy consumption **by 50% in existing buildings and by at least 35% in new construction**.

Lighting control systems utilize switches and relays, dimmers and ballasts, occupancy and motion sensors, photosensors, as well as many other devices to control power usage in a building and thereby **save money**.

**Lighting control systems control power usage through the automatic switching or dimming of lighting loads.** Some systems even manage a building's environment.



# Market Drivers - Energy Legislation

## US Green Building Council (USGBC) LEED

Building certification program which promotes integrated, whole-building practices



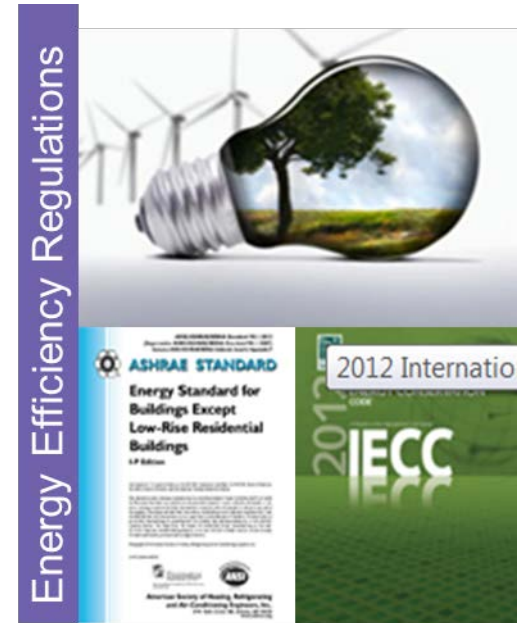
## Energy Policy Act (EPACT)

Mandates that all states must have energy codes in place that meet ASHRAE 90.1 as a minimum.

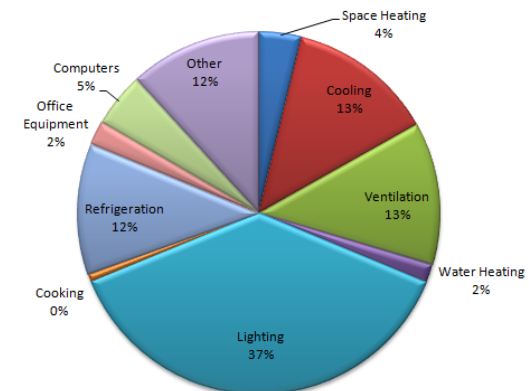
## ASHRAE 90.1

All buildings > 5000 sq-ft are required to have lighting control.

All exterior lighting must have automatic control system.



Electricity Use Commercial



# Market Segments

- Federal, state and local governments
- K-12 schools and universities
- Healthcare
- Commercial
- Retail
- Industrial
- Laboratories and research institutions
- Data centers
- Water and wastewater treatment



# Megatrends

---

- ↑ Government regulations, LEED, sustainability
- ↓ Great connectivity and smarter devices
- ↑ Eliminating the need for application software
- ↑ Granularity of control increasing
- ↑ More efficient lighting (LED)
- ↔ Diminishing incandescent
- ↑ Desire for a more energy-centric approach
- ↓ Desire for comprehensive solution control providers
- ↓ Distributed and fixture-based controls
- ↑ More systems, less islands
- ↑ Increasing requirement for metering

# Major Product Categories

Categories may have application overlap and synergies:



- Distributed Control Systems – Application specific control components typically installed near utilization devices



- Breaker-Based Control Systems – Centralized control system with core functionality embedded in the electrical distribution gear



- Relay-Based Control Systems – Centralized control system with the core functionality installed after the distribution equipment



- Hospitality EMS – In-room systems for HVAC and lighting control; Emerging as an extension of lighting controls market



- Occupancy Sensors – Detection devices used to directly control circuits or provide a signal to another system



- Emergency Lighting Control Devices – Specialty devices required to meet specific aspects of the electrical code



- Track-Limiting Panels – Supplemental circuit protection prevents additional fixtures on lighting tracks

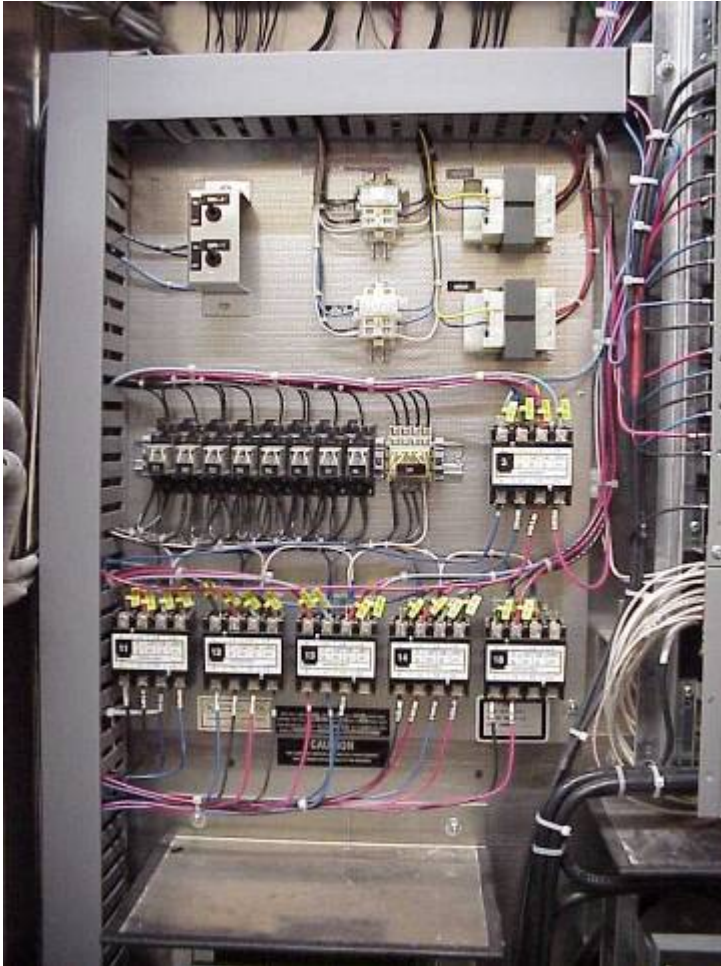


---

Mechanically Latched Contactor Control  
vs.  
Controllable Circuit Breaker



# Mechanically Latched Contactor Control



- Contactor Panels
- Complicated
- Labor Intensive
- Site Installed
- Difficult to override lights when contactors fail
- Requires considerable wall space to mount

# Controllable Circuit Breaker

## Value Proposition

- Integrates lighting control and requires less space
- Reduces project construction cycle time
- Eliminates complicated control wiring
- Increases flexibility for monitoring and control of each branch circuit.
- Increases diagnostic maintenance
- Building retrofit reconfiguration flexibility
- Day light harvesting control

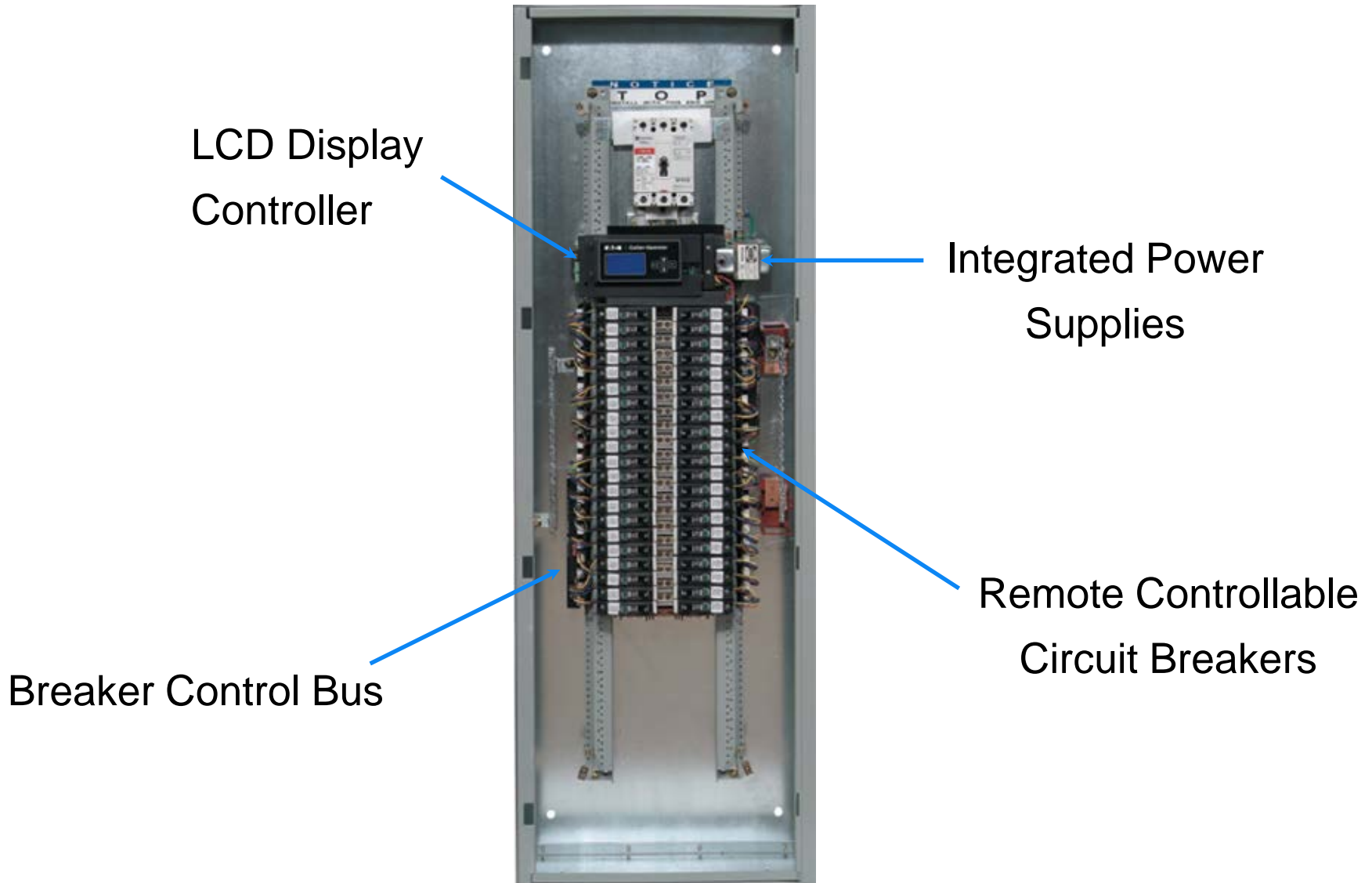


- Rated at (277/480V) or (208/120V)
- 1 & 2 Pole
- 15, 20 & 30 Amp

---

# Integrated Lighting Control Panelboard

# Integrated Lighting Panelboard - Interior



# Integrated Lighting Panelboard - Features

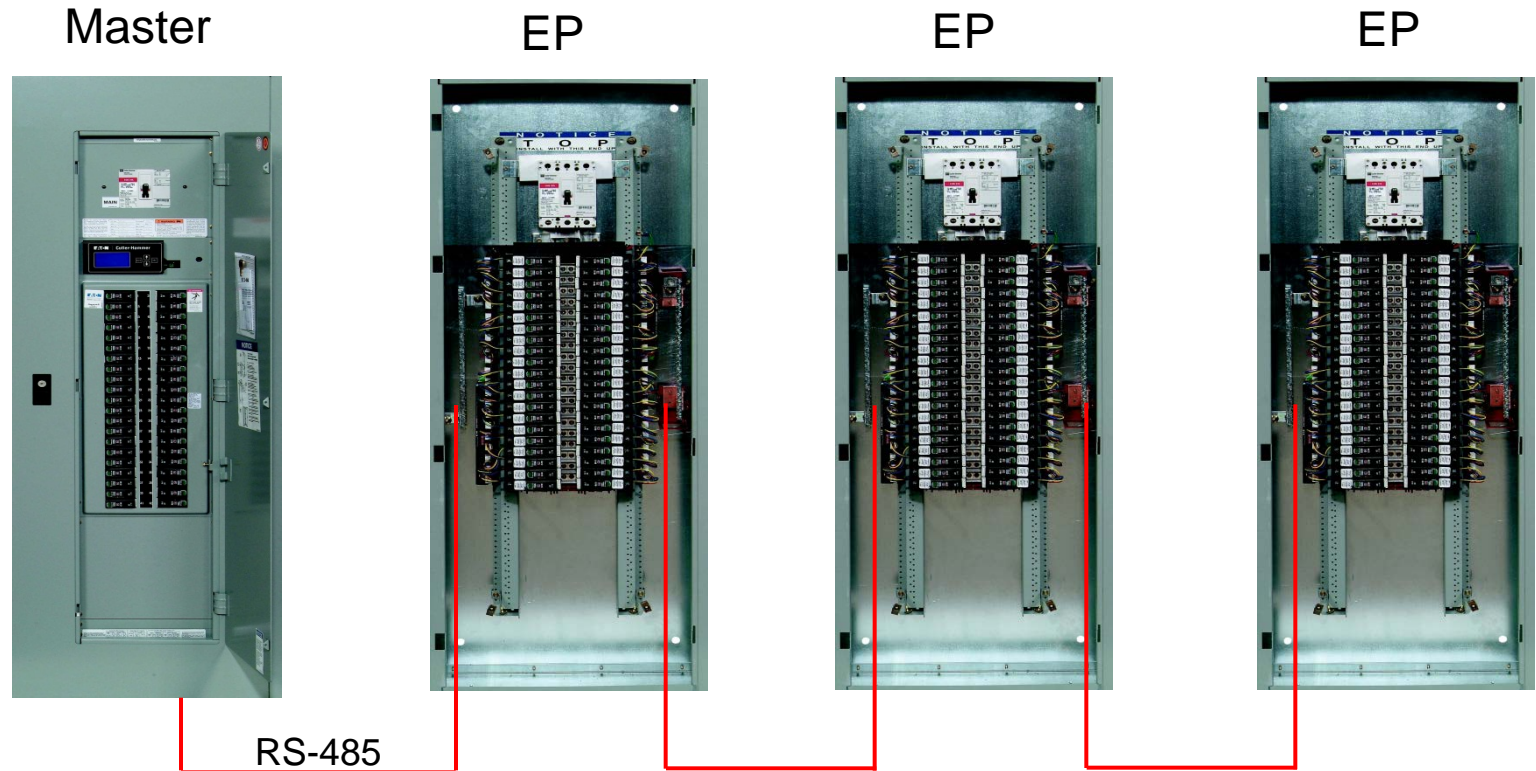
- Inputs
  - 8 Digital
  - 8 Universal
- Outputs
  - 8 Digital
  - 4 Analog
- External devices power supply
  - 24V AC
  - 15V DC



---

# Stand-Alone System

# Stand-Alone – New Construction



- Control 168 remote controllable circuit breakers
- Local programming – No software

---

# Networked Panelboard System



# Networked Panelboard System



## Com Ports

- Ethernet
- RS-485

## Inputs

- 8 Digital
- 8 Universal

## Outputs

- 8 Digital
- 4 Analog

## Protocol

- BACnet
- Soap/XML
- OPC

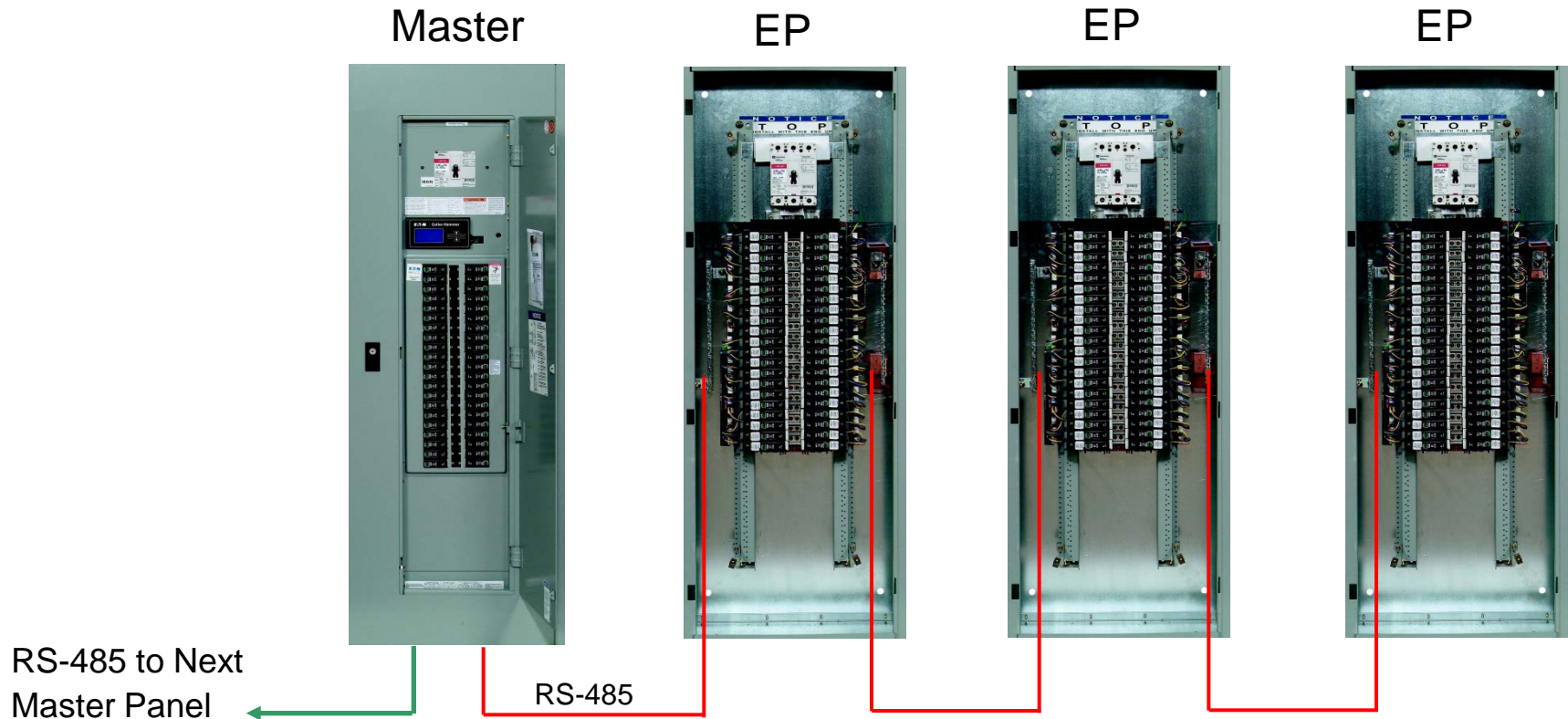
## Lighting Control Functions

- Time of Day On/Off Scheduling
- Input/Output Matrix Across Controllers
- Historical Logging
- Dimming
- Daylight Harvesting
- Distributed Intelligence
- Day/Date/Year/Time
- Daylight Savings
- Holiday Scheduling
- Memory Loss Protection
- Hardware Diagnostics
- Power Failure Recovery
- Alarms
- Lights Off Warning
- Load Priority Management
- Manual Load On/Off Override



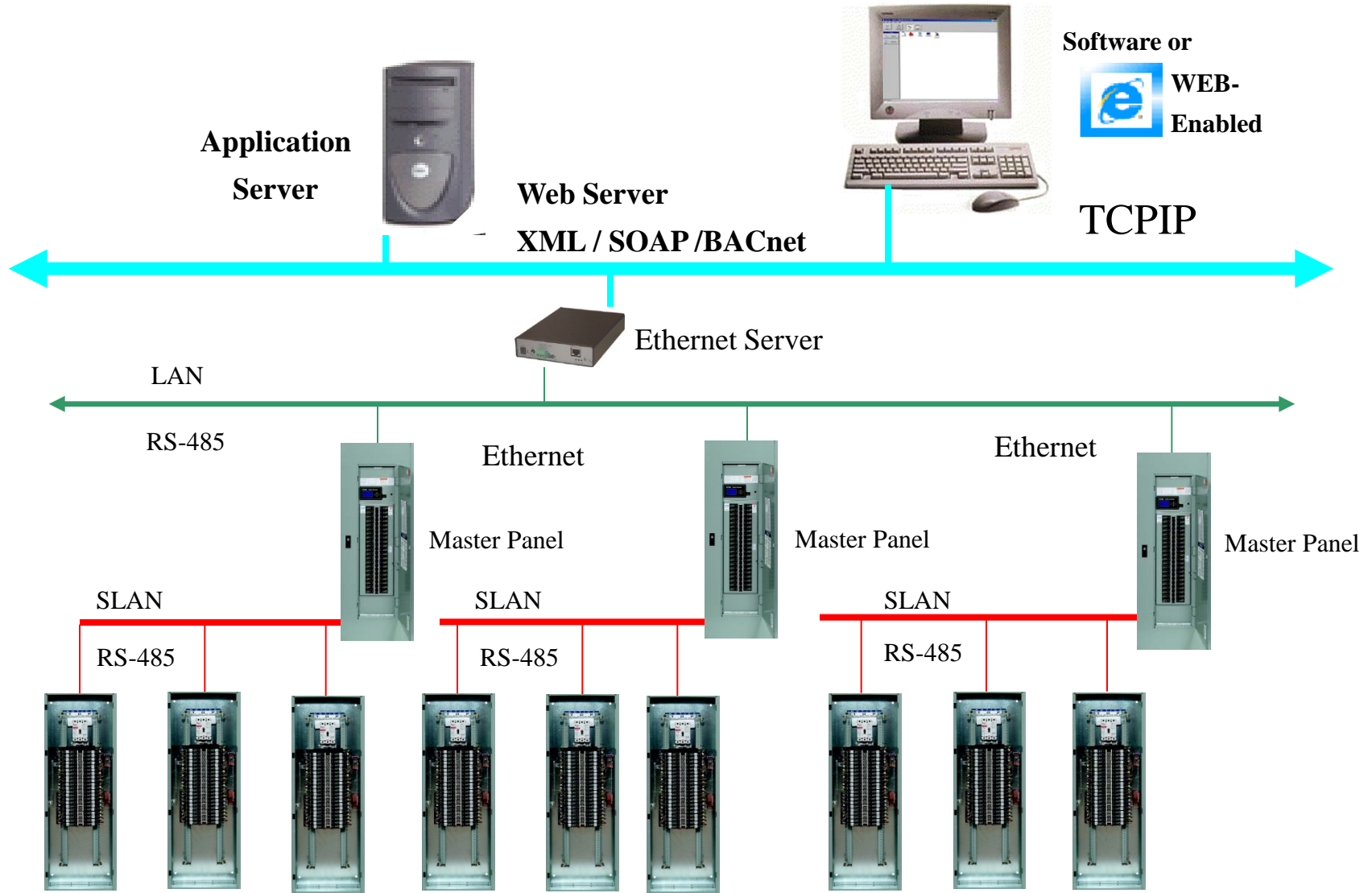
## Optional LCD Display

# Networked System - New Construction



- Control 168 remote controllable circuit breakers
- Local programming – No software

# Networked System - Architecture



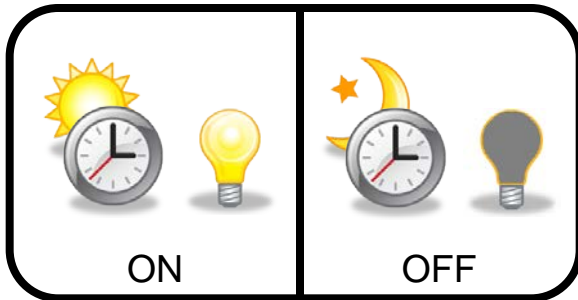
---

# Control Strategies

# Control Strategies

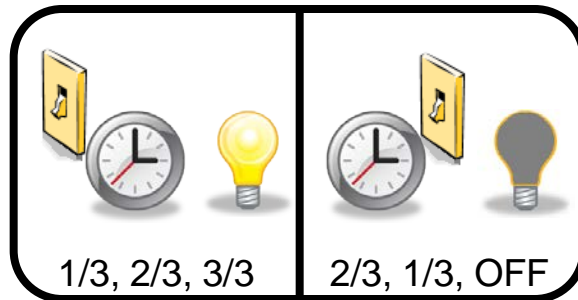
## Strategy

## Savings



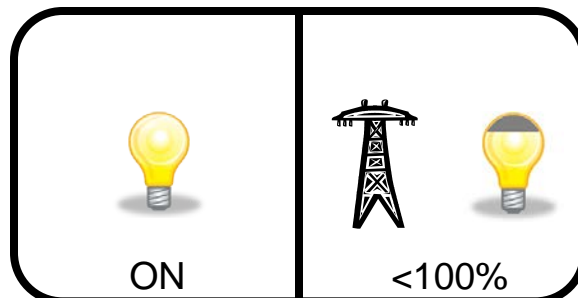
- **Scheduling (switching)** turns lights ON only when needed

20-30%



- **Bi-level switching** (3-lamp fixtures) provides 1/3, 2/3 and 3/3 light levels and savings

15-20%



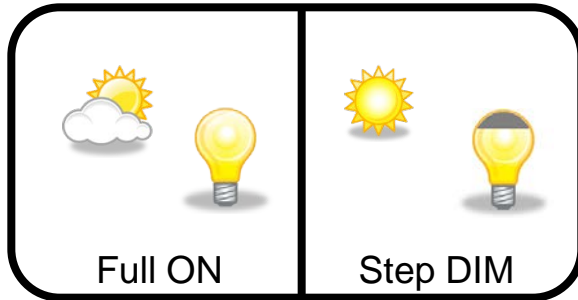
- **Demand response** automatically reduces (switch OFF or dim) lighting during peak usage times

Variable

# Control Strategies

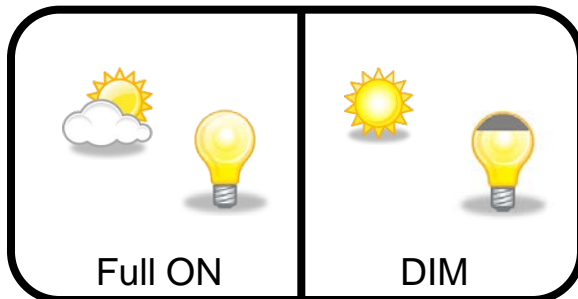
## Strategy

## Savings



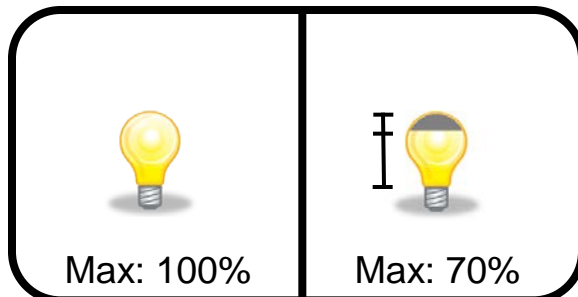
- **Daylight harvesting (switching)** automatically turns lights OFF when daylight is available

15-20%



- **Daylight harvesting (dimming)** enables maintains desired light level by combining natural and artificial light

15-20%



- **High-end trim** limits the maximum light level based on customer light level and savings requirements

20%

---

# Web-Enabled Controllers

# Web Enabled Panelboard



## Com Ports

- Ethernet
- RS-485

## Inputs

- 8 Digital
- 8 Universal

## Outputs

- 8 Digital
- 4 Analog

## Protocol

- BACnet
- Soap/XML
- OPC

## Lighting Control Functions

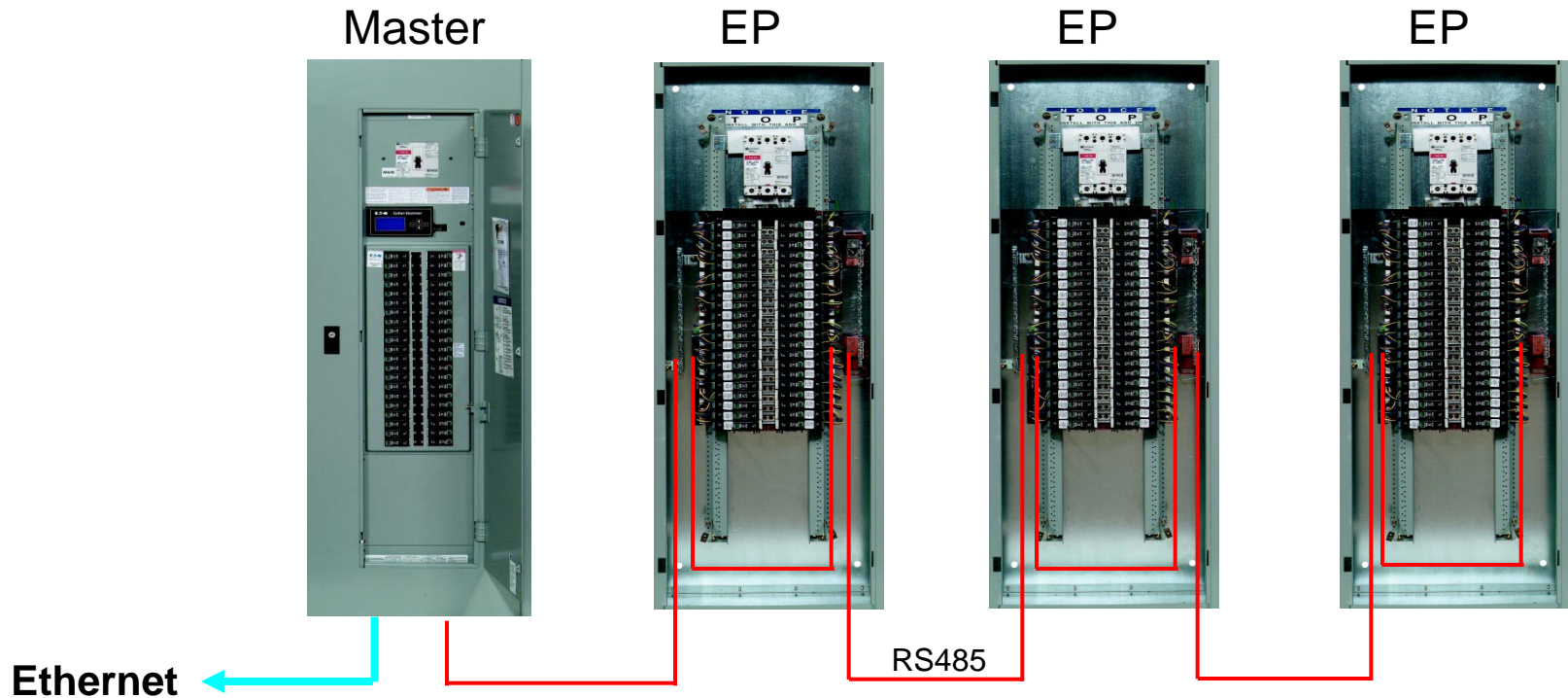
- Time of Day On/Off Scheduling
- Input/Output Matrix Across Controllers
- Historical Logging
- Dimming
- Daylight Harvesting
- Distributed Intelligence
- Day/Date/Year/Time
- Daylight Savings
- Holiday Scheduling
- Memory Loss Protection
- Hardware Diagnostics
- Power Failure Recovery
- Alarms
- Lights Off Warning
- Load Priority Management
- Manual Load On/Off Override



## Optional LCD Display



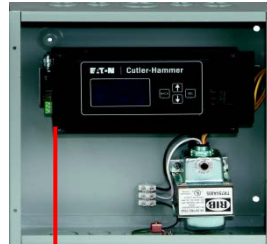
# Web-Enabled - New Construction



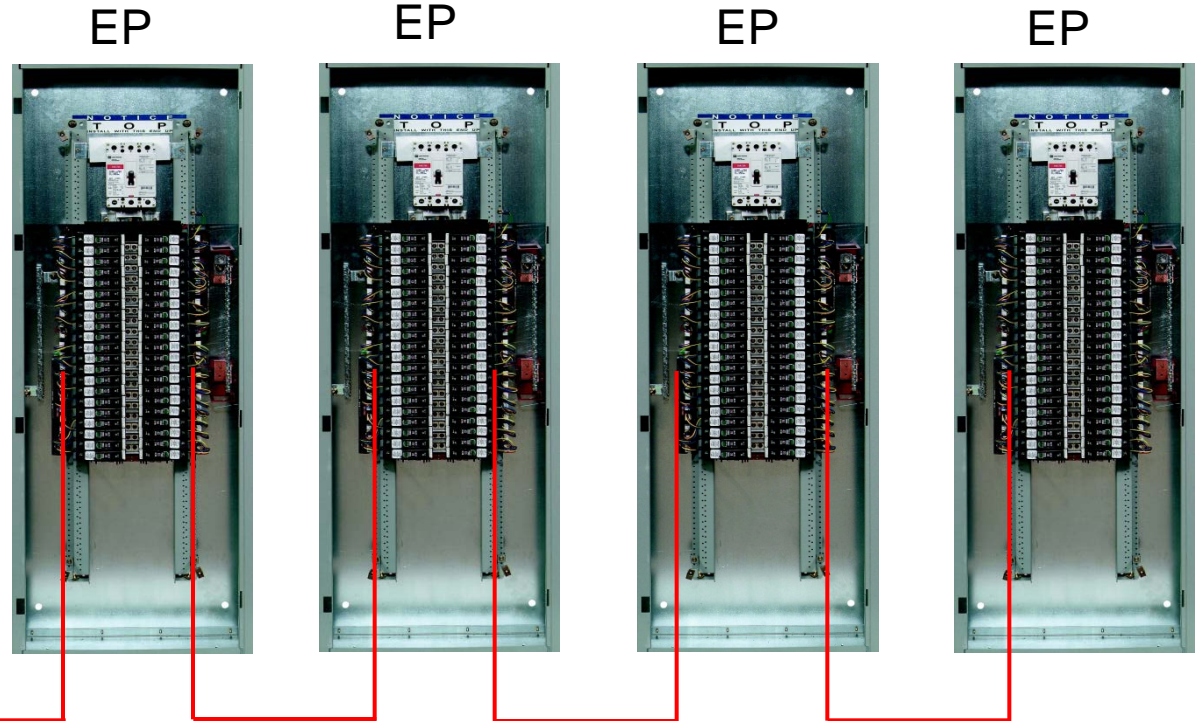
- Fluorescent Dimming Control STANDARD
- Reduced Size - Built on STANDARD PRL1a\2a
- Control 168 breakers

# Retrofit Solution

External Control  
Cabinet

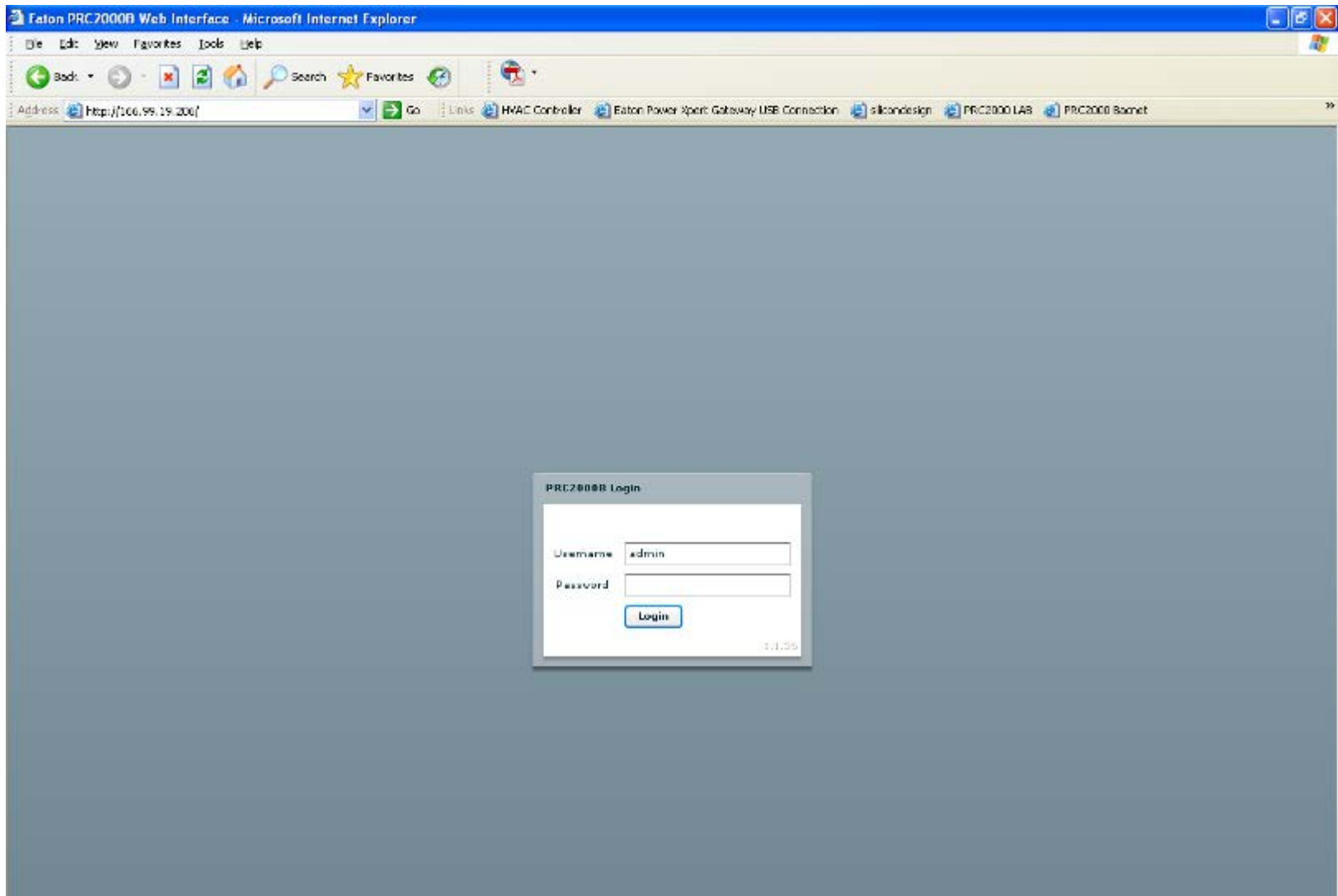


RS-485



- Install the breaker control bus rails
- Replace existing breakers with controllable circuit breakers

# Web-Enabled Log In



# Web-Enabled - Breaker Status

Eaton PRC2000B Web Interface - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address: http://166.99.19.206/

Links: HVAC Controller Eaton Power Xpert Gateway USB Connection silicondesign PRC2000 LAB PRC2000 Bacnet

Breakers Groups Inputs Schedules Holidays Messages System Configuration

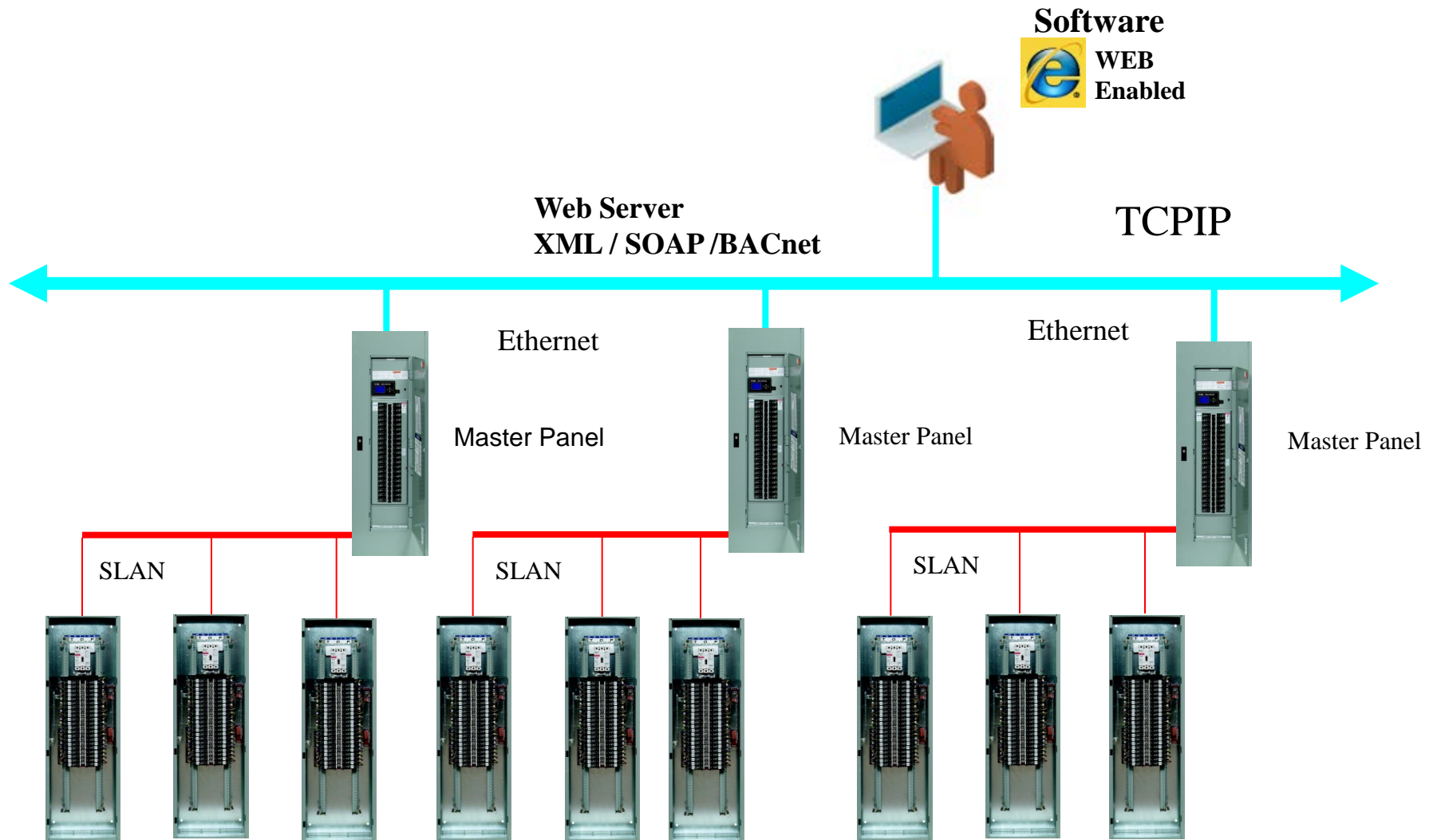
GRPA GRPB GRPC GRPD GRPE GRPF GRPG GRPH GRPI GRPJ GRPK GRPL GRPM GRPN GRPO GRPP

Panels: 1 2

Name: PNL1 Type: Left				Name: PNL1 Type: Right			
Name	Description	Group(s)	Status	Status	Group(s)	Description	Name
B101	Front Lobby	AB-----K---OP	1 OFF	ON	2	-B-----P	Parking Lot V B102
B103	Front Hall	AB-----K---OP	3 OFF	ON	4	---D-----P	Parking Lot W B104
B105	West Hall	A-----J---OP	5 OFF	ON	6	-B-----P	Office 2 B106
B107	West Hall	A-----J---WOP	7 OFF	ON	8	-B-----P	Meeting Room B108
B109	East Hall	A-----J---OP	9 OFF	ON	10	-B-----P	Meeting Room B110
B111	East Hall	A-----I---OP	11 OFF	ON	12	-B-----P	Office 3 A/B B112
B113	Stairs	A-----J---OP	13 OFF	ON	14	-B-----P	Office 4 A/B B114
B115	Main Office	-----I---OP	15 OFF	ON	16	-B-----P	Office 5 A/B B116
B117	Conference Room A	---E---J---P	17 OFF	ON	18	--C-----P	Warehouse B118
B119	Conference Room B	---F---J---P	19 OFF	ON	20	--C---H---P	Warehouse B120
B121	Conf Room B Front	---G-I-K---P	21 OFF	ON	22	--C-----P	Assembly Area B122
B123	Office 6	---F---J---P	23 OFF	ON	24	--C-----P	Assembly Area B124
B125	Conf Room B Front	---G-I-K---P	25 OFF	ON	26	---D---H---P	Exterior-Front B126
B127	Office 7	---G-I-K---P	27 OFF	ON	28	---D---H---P	Exterior S. B128
B129	Break Room	---F---I-K---P	29 OFF	ON	30	---D---H---P	Exterior N. B130
B131	Break Room	---F---I-K---P	31 OFF	ON	32	-----P	B132
B133	Office 8	---F---I-K---P	33 OFF	ON	34	-----P	B134
B135	Office 9	---F---I---P	35 OFF	OFF	36	-----P	B136
B137	Kitchen	---F---I---P	37 OFF	OFF	38	-----P	B138
B139	Kitchen	---F---I---P	39 OFF	OFF	40	-----P	B140
B141	Office 1	-----P	41 OFF	OFF	42	-----P	B142

Commanded State: "ON" "OFF" Feedback State: ON OFF [Flashing] Mismatch Service State: Normal Override

# Web-Enabled - Architecture



---

# Customized Color Graphics

# Customized Color Graphics

MAIN FLOOR SELECTION.dsp - Color Windows Application

File Options Back Help

Nebraska Furniture Mart  
Kansas City

PAVILION / ROOF PWR

MAINTENANCE

**NFMA Time Schedule**

- SCHEDULE A
- SCHEDULE B
- SCHEDULE C
- SCHEDULE D
- SCHEDULE E
- SCHEDULE F
- SCHEDULE G
- SCHEDULE H
- SCHEDULE I
- SCHEDULE J
- SCHEDULE K
- SCHEDULE L
- SCHEDULE M
- SCHEDULE N
- SCHEDULE O
- SCHEDULE P

UPPER LEVEL

LOWER LEVEL

**NFMB Time Schedule**

- SCHEDULE A
- SCHEDULE B
- SCHEDULE C
- SCHEDULE D
- SCHEDULE E
- SCHEDULE F
- SCHEDULE G
- SCHEDULE H
- SCHEDULE I
- SCHEDULE J
- SCHEDULE K
- SCHEDULE L
- SCHEDULE M
- SCHEDULE N
- SCHEDULE O
- SCHEDULE P

No Connection Wednesday, May 19, 2004 1:30 PM

# Customized Color Graphics

FLOOR 200.dsp - Color Windows Application

File Options Back Help

Nebraska Furniture Mart  
Kansas City

## UPPER LEVEL

**NFMA Time Schedule**

- SCHEDULE A
- SCHEDULE B
- SCHEDULE C
- SCHEDULE D
- SCHEDULE E
- SCHEDULE F
- SCHEDULE G
- SCHEDULE H
- SCHEDULE I
- SCHEDULE J
- SCHEDULE K
- SCHEDULE L
- SCHEDULE M
- SCHEDULE N
- SCHEDULE O
- SCHEDULE P

**MAIN**

**LOWER LEVEL**

**NFMB Time Schedule**

- SCHEDULE A
- SCHEDULE B
- SCHEDULE C
- SCHEDULE D
- SCHEDULE E
- SCHEDULE F
- SCHEDULE G
- SCHEDULE H
- SCHEDULE I
- SCHEDULE J
- SCHEDULE K
- SCHEDULE L
- SCHEDULE M
- SCHEDULE N
- SCHEDULE O
- SCHEDULE P

No Connection Wednesday, May 19, 2004 1:33 PM







---

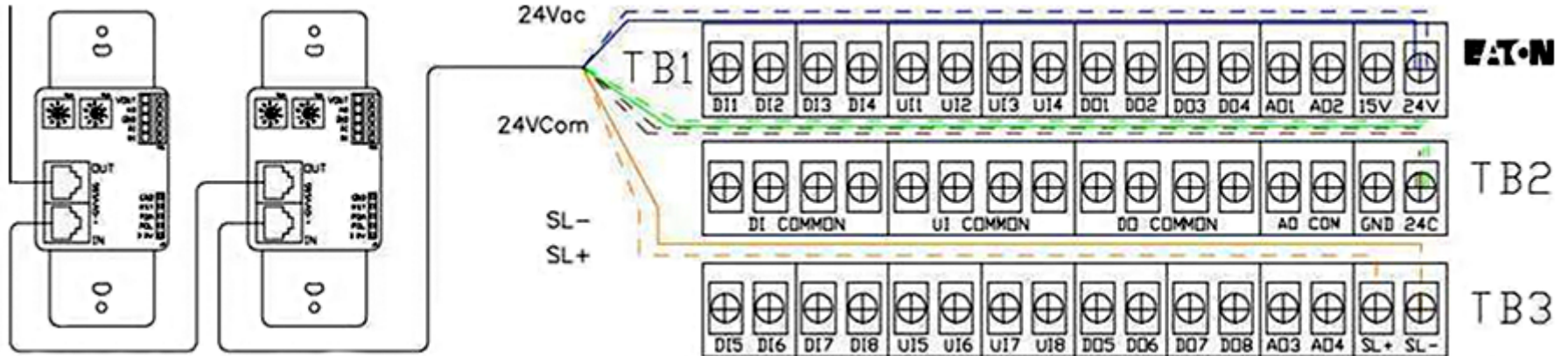
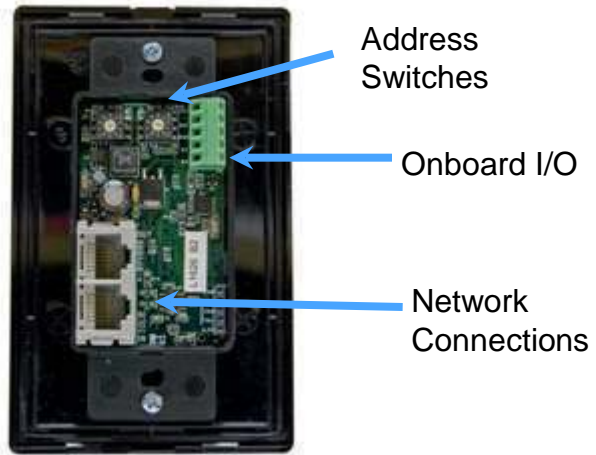
# Digital Switches

# Digital Switch Features

- 2-, 4-, and 6-button configurations
- White, Black and Almond
- Button status LED indicator
- Addressable from 1 to 99
- Configuration options:
  - Web page or software
  - Digital switch dimming requires software
- Programmable buttons provide:
  - ON/OFF switching
  - Step and Full dimming

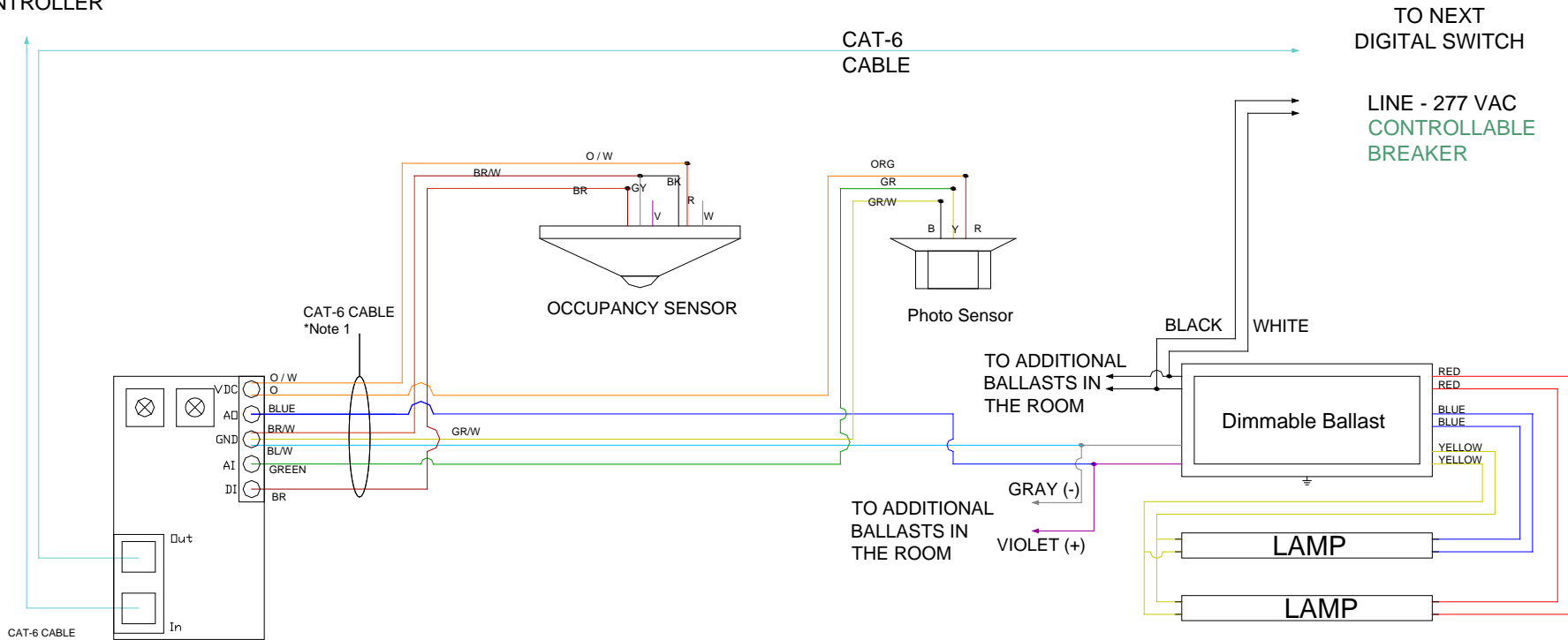


# Digital Switch Wiring Diagram



# Digital Switch Wiring Diagram

FROM PREVIOUS  
DIGITAL SWITCH  
OR PRC2000  
CONTROLLER



---

# Wireless Lighting Control

# Wireless Lighting Control

---

- **Wireless Lighting Control**

- Designed to lower the cost of labor and material when installing lighting control.
- Excellent for retrofit, as well as new construction applications.
- All configuration and control can be done through a standard Web browser – no software required.
- The system consists of:
  - **Controller** - performs seamless control of every lighting zone in the facility through wireless commands sent up to 100 wireless nodes.
  - **Wireless I/O modules** - allows local connectivity of low voltage switches, photo sensors, occupancy sensors, and 0 – 10 V DC dimming ballasts. Also adds the ability to perform on/off power switching through an onboard relay for lighting circuits up to 20 amperes. Running control wires from each device in the facility back to the electrical room is no longer required.
  - **Wireless switches** - Each switch has the ability to communicate to Smart Panelboards through a wireless switch Interface unit or communicate directly to the wireless controller.

# Wireless Controller



- Central control and monitoring of all lighting
  - Time-of-Day Scheduling
  - Configured using web pages
- 802.15.4 Wireless Communications
- Ethernet & Modbus Communications
- Decimal Addressing Switches
- 15 Vdc 100 mA output to power auxiliary devices.
- Eight universal inputs (analog or digital) for:
  - Dry Contact Switches
  - Occupancy sensors
  - Demand meters
  - 0 to 5 Vdc Photo sensors input
- Four analog outputs for 0 to 10V dimming ballast control
- Four digital outputs for control of auxiliary devices



# Wireless I/O Module

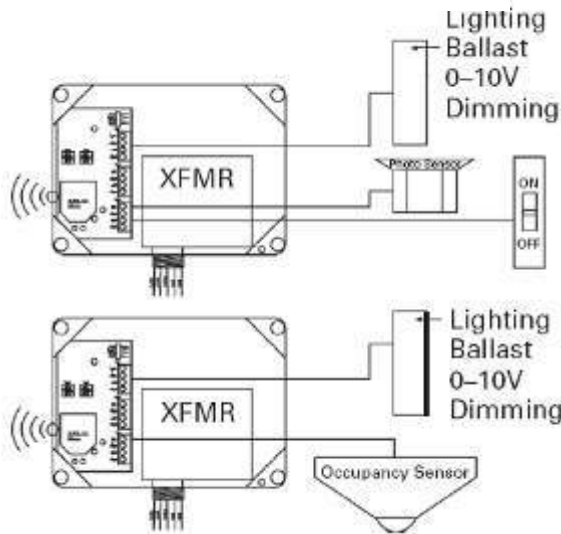


## **Embedded Control Functions**

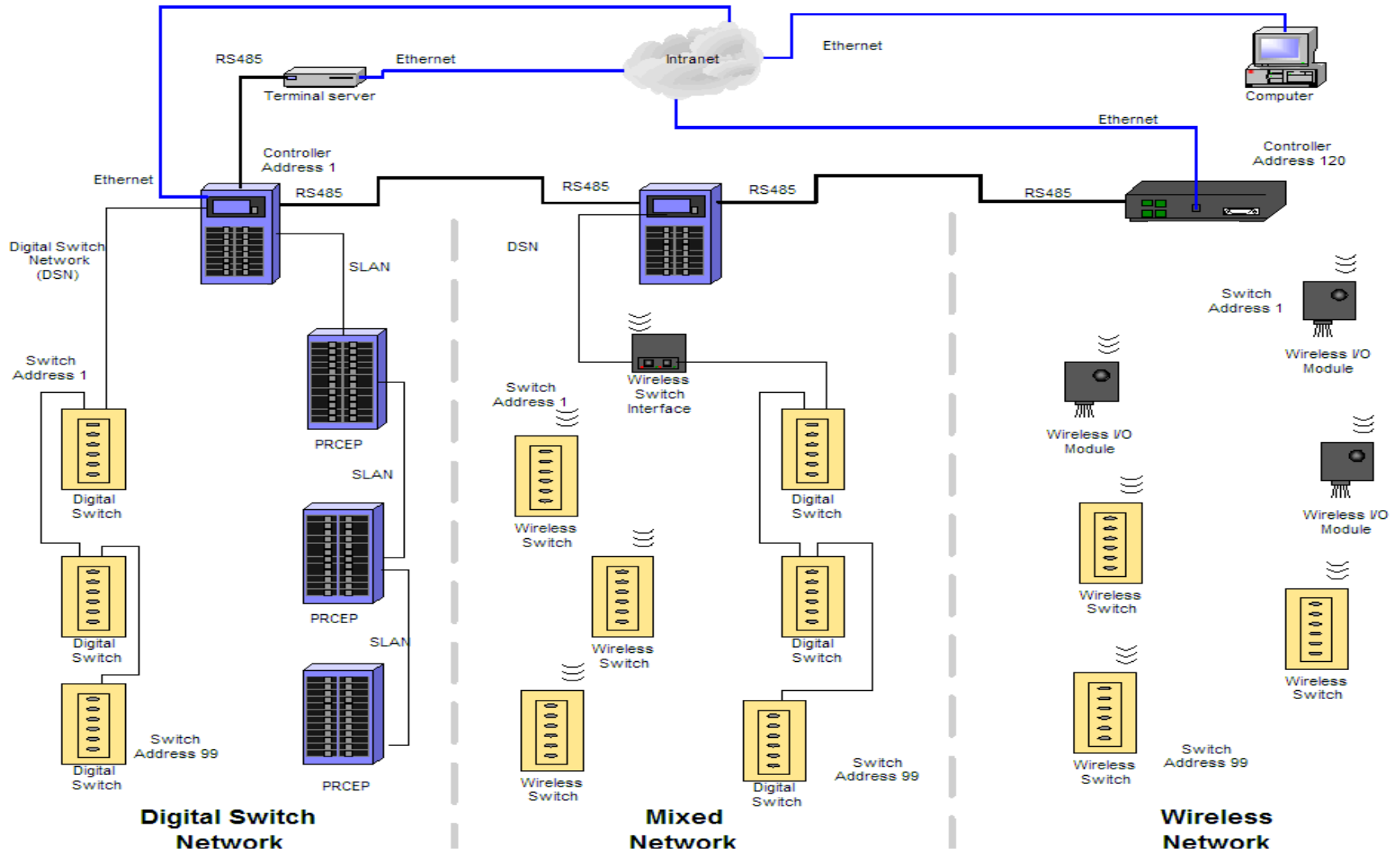
- Designed to easily mount above the drop ceiling next to any dimmable lighting ballast.
- One, 20amp/277vac single pole lighting relay
- Two, digital inputs for switches, Occupancy Sensors or Demand Meter Pulses
- Two, universal inputs (analog or digital) for Photolight sensor control of Daylight Harvesting
- One, 0 – 10V Analog Output (controls up to 40 dimming ballasts)
- 802.15.4 Communications
- Decimal Addressing Switches
- Configured from the PRC4000 using web pages

## **Central Control Functions**

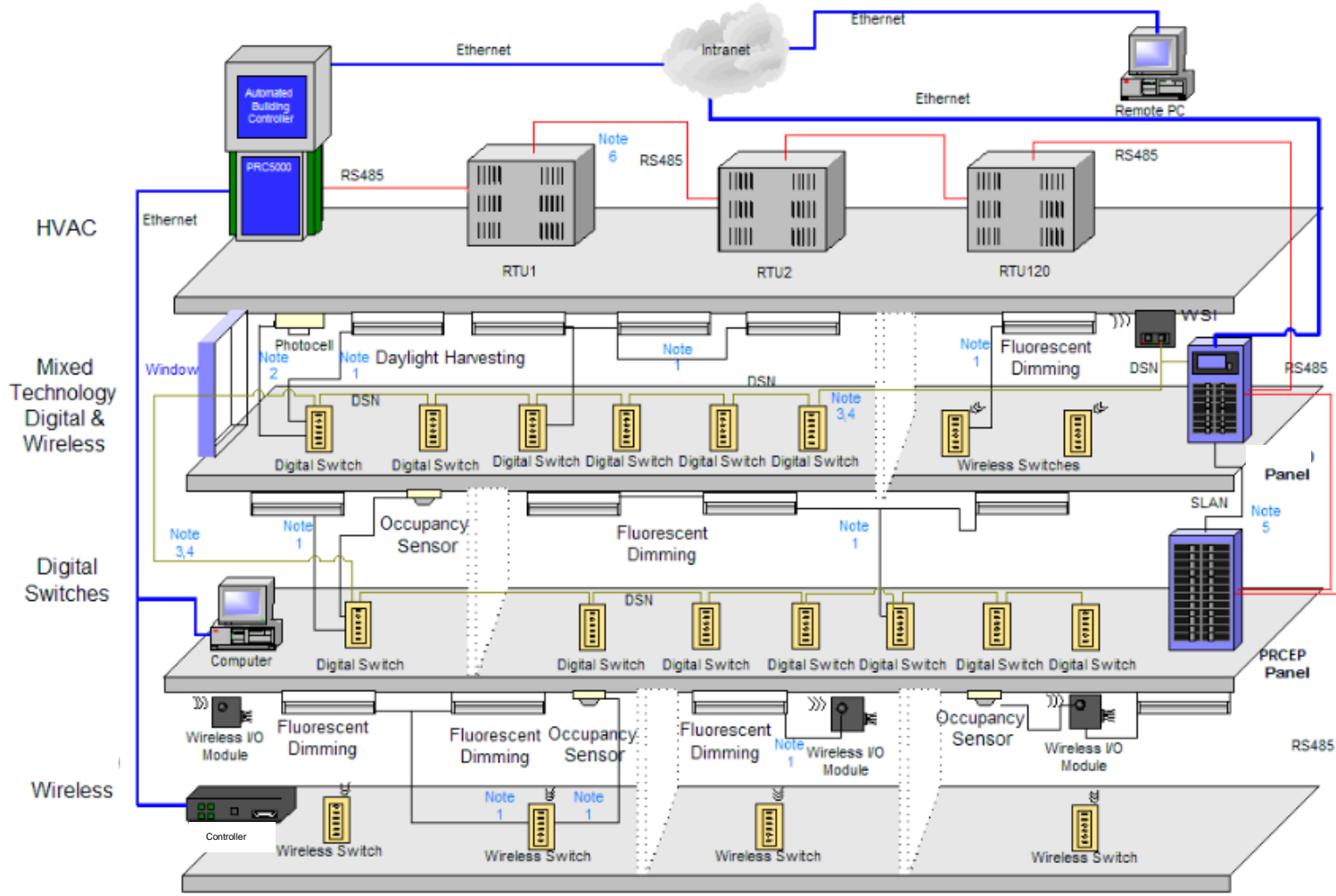
- Building wide demand reduction thru preset limits
- Programmed from a central point
- Lighting levels can be monitored from a central point
- Lighting set points can be changed from a central point



# Network Architecture

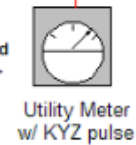


# Building Network Architectures



**Notes:**

- |  |  |   |
|--|--|---|
| <p>1. 0-10 V DC Dimming ballasts and motion detectors:<br/>         16 AWG 2500ft max.<br/>         20 AWG 1000ft max.</p> <p>2. Photocell:<br/>         Twisted/shielded pair<br/>         16 AWG 2500ft max.<br/>         20 AWG 1000ft max.</p> | <p>3. Digital Switch Network is CAT6 cable daisy-chained with RJ45 connectors on each end. A DSN Power Injector is needed after 15 switches or 500 feet whichever comes first.</p> <p>4. 16 AWG 150 feet max.</p> <p>5. 24Vac control transformer at 75VA needed if a longer distance is required. Adds 15 switches or 500 feet.</p> | <p>6. Controller cards installed in each and thermostats installed in each zone. Max 120 devices.</p> |
|--|--|---|



# Questions

---

