Atlanta Chapter – IEEE Industry Applications Society

Presenter: Alan Wyant

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Agenda

- 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.
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

- LCD Display
- Controller
- Integrated Power Supplies
- Remote Controllable Circuit Breakers
- Breaker Control Bus
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

RS-485
Networked Panelboard System
Networked Panelboard System

**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

**Com Ports**
- Ethernet
- RS-485

**Inputs**
- 8 Digital
- 8 Universal

**Outputs**
- 8 Digital
- 4 Analog

**Protocol**
- BACnet
- Soap/XML
- OPC

**Optional LCD Display**
Networked System - New Construction

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

- Application Server
- Web Server
  - XML / SOAP / BACnet
  - TCPIP
- Ethernet Server
- LAN
  - Ethernet Server
  - Master Panel
  - SLAN
  - RS-485
- Ethernet
  - Master Panel
  - SLAN
  - RS-485
- Ethernet
  - Master Panel
  - SLAN
  - RS-485

Software or WEB-Enabled
Control Strategies
Control Strategies

- **Scheduling (switching)** turns lights ON only when needed. Savings: 20-30%
- **Bi-level switching** (3-lamp fixtures) provides 1/3, 2/3 and 3/3 light levels and savings. Savings: 15-20%
- **Demand response** automatically reduces (switch OFF or dim) lighting during peak usage times. Savings: Variable
Control Strategies

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daylight harvesting (switching) automatically turns lights OFF when daylight is available</td>
<td>15-20%</td>
</tr>
<tr>
<td>Daylight harvesting (dimming) enables maintains desired light level by combining natural and artificial light</td>
<td>15-20%</td>
</tr>
<tr>
<td>High-end trim limits the maximum light level based on customer light level and savings requirements</td>
<td>20%</td>
</tr>
</tbody>
</table>
Web-Enabled Controllers
Web Enabled Panelboard

**Lighting Control Functions**
- Time of Day On/Off Scheduling
- Input/Output Matrix Across Controllers
- Historical Logging
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**Optional LCD Display**
Web-Enabled - New Construction

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

- Install the breaker control bus rails
- Replace existing breakers with controllable circuit breakers
Web-Enabled Log In
# Web-Enabled - Breaker Status

![Web-Enabled Breaker Status Interface](image-url)

## Breaker Status Table

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Left</th>
<th>Status</th>
<th>Name</th>
<th>Type</th>
<th>Right</th>
<th>Status</th>
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<tbody>
<tr>
<td>B101</td>
<td></td>
<td></td>
<td>OFF</td>
<td>Parking Lot V</td>
<td>B102</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B103</td>
<td></td>
<td></td>
<td>OFF</td>
<td>Parking Lot W</td>
<td>B104</td>
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<td></td>
</tr>
<tr>
<td>B105</td>
<td></td>
<td></td>
<td>OFF</td>
<td>Office 2</td>
<td>B106</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B107</td>
<td></td>
<td></td>
<td>OFF</td>
<td>Meeting Room</td>
<td>B108</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B109</td>
<td></td>
<td></td>
<td>OFF</td>
<td>Meeting Room</td>
<td>B110</td>
<td></td>
<td></td>
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<tr>
<td>B111</td>
<td></td>
<td></td>
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<td>Office 3 A/B</td>
<td>B112</td>
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<tr>
<td>B113</td>
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<td>B115</td>
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<td>Warehouse</td>
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<td></td>
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<td></td>
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<td></td>
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<td>Assembly Area</td>
<td>B122</td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
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<td>Assembly Area</td>
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<td>Exterior Front</td>
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<td>Exterior S.</td>
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<td>B126</td>
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<td>OFF</td>
<td>Exterior N.</td>
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<td>B127</td>
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<td></td>
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<td>B132</td>
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<td>B128</td>
<td></td>
<td></td>
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<td>Office 2</td>
<td>B134</td>
<td></td>
<td></td>
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<tr>
<td>B129</td>
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<td></td>
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<td>Office 3</td>
<td>B136</td>
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<td></td>
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<tr>
<td>B130</td>
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<td>Office 4</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>B131</td>
<td></td>
<td></td>
<td>OFF</td>
<td>Office 5</td>
<td>B140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B132</td>
<td></td>
<td></td>
<td>OFF</td>
<td>Office 1</td>
<td>B142</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Commanded States
- ON
- OFF

## Feedback States
- Normal
- Override
Web-Enabled - Architecture

- Web Server
  - XML / SOAP / BACnet

- TCPIP

- Ethernet
  - Master Panel
  - SLAN

- Master Panel
  - Ethernet
  - SLAN

Software Embodied as WEB Enabled
Customized Color Graphics
Customized Color Graphics
Customized Color Graphics
Customized Color Graphics

See Courtyard Cafe
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

- Address Switches
- Onboard I/O
- Network Connections
Digital Switch Wiring Diagram

FROM PREVIOUS DIGITAL SWITCH OR PRC2000 CONTROLLER

CAT-6 CABLE

OCCUPANCY SENSOR

TO ADDITIONAL BALLASTS IN THE ROOM

TO ADJACENT BALLASTS IN THE ROOM

CAT-6 CABLE

O/W

BR/W

GR/W

OR

Photo Sensor

TO ADDITIONAL BALLASTS IN THE ROOM

TO NEXT DIGITAL SWITCH

LINE - 277 VAC CONTROLLABLE BREAKER

Dimmable Ballast

LAMP

LAMP

FROM PREVIOUS DIGITAL SWITCH OR PRC2000 CONTROLLER

Cat-6 CABLE

O/W

BR/W

GR/W

OR

Photo Sensor

TO ADDITIONAL BALLASTS IN THE ROOM

TO NEXT DIGITAL SWITCH

LINE - 277 VAC CONTROLLABLE BREAKER

Dimmable Ballast

LAMP

LAMP
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:
1. 0-10 V DC Dimming ballasts and motion detectors: 16 AWG 2500ft max., 20 AWG 1000ft max.
2. Photocell: twisted/shielded pair 2500ft max., 16 AWG 1000ft max.
3. Digital Switch network is CAT6 cable digitally chained with RJ45 connectors on each end. A DSN Power injector is needed after 15 switches or 500 feet whichever comes first. 16 AWG 150 feet max.
4. 24V ac control transformer at 75VA needed if a longer distance is required. Adds 15 switches or 500 feet.
5. Controller cards installed in each and thermostats installed in each zone. Max 120 devices.
6. Utility Meter with KYZ pulse
Questions