Control technology trends

- Analog: out...eventually
- Digital wired: has been available commercially for years
- Digital wireless: finally hitting mainstream
- Color control: still nascent, but growing interest
Sensors and controls

- Common today (well understood and widely deployed)
  - Occupancy sensors
  - Daylight sensors
  - Personal and wall controls
  - *In many cases, required by code*

- Future sensors (in R&D and trial installs)
  - “Presence detectors” (video-based occupancy sensors)
  - Air or component temperature sensors (in fixtures)
  - \( \text{CO}_2 \) / air quality sensors
  - *Customers need to understand the value proposition*
Benefits of dimming control

**Qualitative:**
- Occupant comfort & productivity
- Positive PR: “going green”
- Greater consistency in energy savings
- Easy to “tweak” to get to desired performance

**Quantitative:**
- Energy savings
- Peak demand reduction
- Monetary savings
- Demand response incentives
What’s the value of controls?

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupancy/vacancy sensing</td>
<td>20-60%¹</td>
</tr>
<tr>
<td>Personal dimming controls</td>
<td>10-20%²</td>
</tr>
<tr>
<td>Daylight harvesting</td>
<td>25-60%³</td>
</tr>
</tbody>
</table>


What’s the value of controls?

Light Level Preference

Source: www.lightrightconsortium.org (Pacific Northwest National Laboratory)
What’s the value of controls?

Lighting Control and Productivity

Note: Even a 1% Productivity increase provides $2 per ft² of annual savings


¹ Assumes $200/ft² annual salary plus benefits
Using Dimming Lighting Controls

Lighting Energy Savings ≈ 60%

Peak savings versus energy savings

Source: Lighting power profiles derived from ten typical Lutron projects ranging in location from New York City, Portland, Boston, and Philadelphia. Cooling power based on a minimum coefficient of performance of 3, which is not reached until mid-day.
Existing analog technologies

- **Phase Control**
  - Will continue to be the primary technology for many years
  - Compatibility problems with LED lamps remains a challenge

- **0-10V**
  - Developed for ballasts, exhibited a resurgence due to LEDs
  - Prone to interference and occasional compatibility problems
Digital wired technologies

- DMX
- DALI and derivatives (EcoSystem)
Common wireless technologies in lighting

- ZigBee
- Z-Wave
- WiFi
- Bluetooth

- Manufacturer-specific
  - ClearConnect
  - SmartCast
Mesh vs. fixed wireless networks

**Mesh network:** messages take a varying path through other devices, based on network-established routing metrics

**Fixed network:** messages take a predetermined path through dedicated devices, established at network commissioning
Control in the analog world

- Daylight sensor wiring
- Occupancy Sensor wiring
- Power (and Control) signal wiring

1. Mains
2. Zone 1
3. Zone 2
4. Zone 3
5. Zone 4

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Control in the digital world: wired

- Digital Controller
- Power wiring (existing)
- Digital control wiring
- Occupancy Group
- Daylight Group
- Wireless Daylight sensor
- Wireless Occ sensor

1. 2. 3. 4.
5. 6. 7. 8.
9. 10. 11. 12.
13. 14. 15. 16.

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Control in the digital world: wireless

Digital Controller

Uses only existing power wiring (not shown)

Occupancy Group

Daylight Group

Wireless Daylight sensor

Wireless Occ sensor

Wireless Occ sensor

Uses only existing power wiring (not shown)
Digital wired technologies

- **Benefits**
  - High reliability
  - Easier to commission/troubleshoot
  - Generally lower design complexity
  - Allows high-performance precision dimming

- **Challenges**
  - Difficult to retrofit
  - Generally higher installation labor
  - Prone to miswire
Wireless technologies

- **Benefits**
  - Ideal for retrofit
  - Lowest installation labor
  - Easy to design: just count fixtures
  - Reduced job risk: changes can be made on the fly without wiring
  - Allows high-performance precision dimming

- **Challenges**
  - Generally more complex (costly) hardware
  - Often more complex commissioning/programming
  - Prone to interference/range limitations
  - More difficult to troubleshoot
Understand the requirements of the market

- It has to work reliably!
  - Sensor/control behavior
  - Wireless performance and reliability
- It has to be easy (to design, install, commission, use, maintain…)
  - “Just count fixtures” (mentally simple, especially for retrofit)
  - Need selection of fixtures (available from multiple companies)
  - Need spectrum of solutions (small to large)
- Details of a job are not always known in advance
  - Job needs and BOM estimates are made with imperfect information
- It has to provide value to ALL parties in the sales channel
  - Reps, distributors, and contractors all play a role
  - The traditional lighting market is very entrenched and slow to change
Thank you!

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