

Creating Value Through Controls

2014 Department of Energy SSL R&D Workshop

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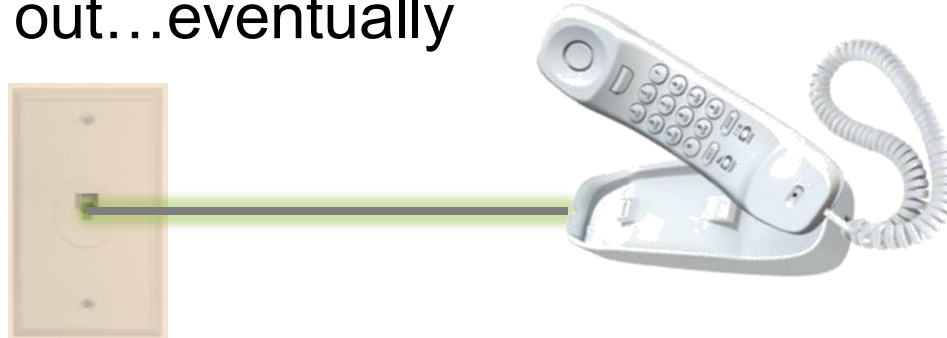
January 27, 2015



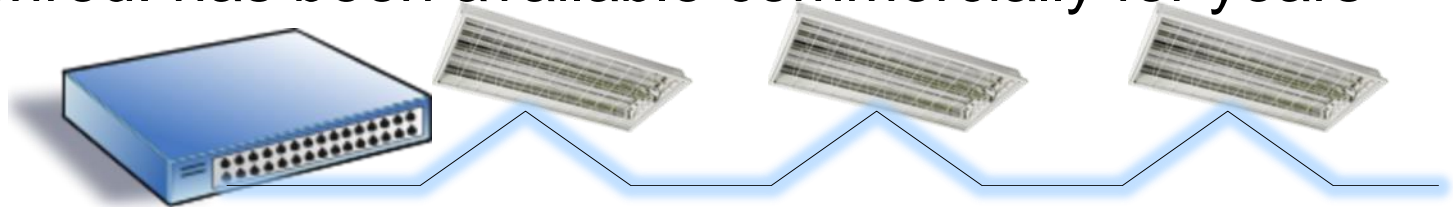
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Control technology trends

- Analog: out...eventually



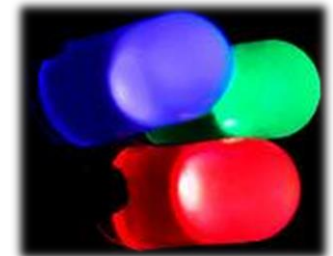
- Digital wired: has been available commercially for years



- 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)
- CO₂ / 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



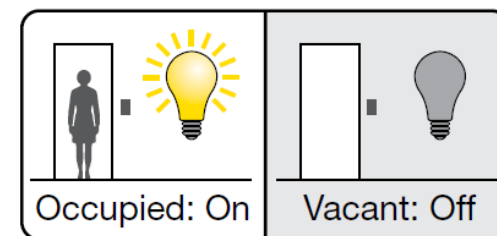
What's the value of controls?

Strategy

Savings

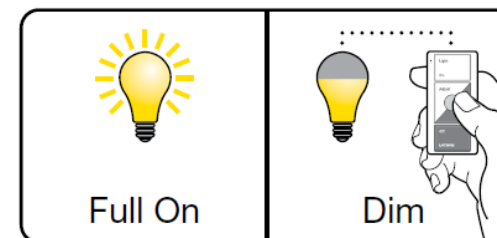
- Occupancy/vacancy sensing

20-60%¹



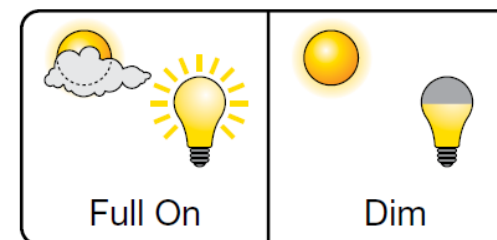
- Personal dimming controls

10-20%²



- Daylight harvesting

25-60%³



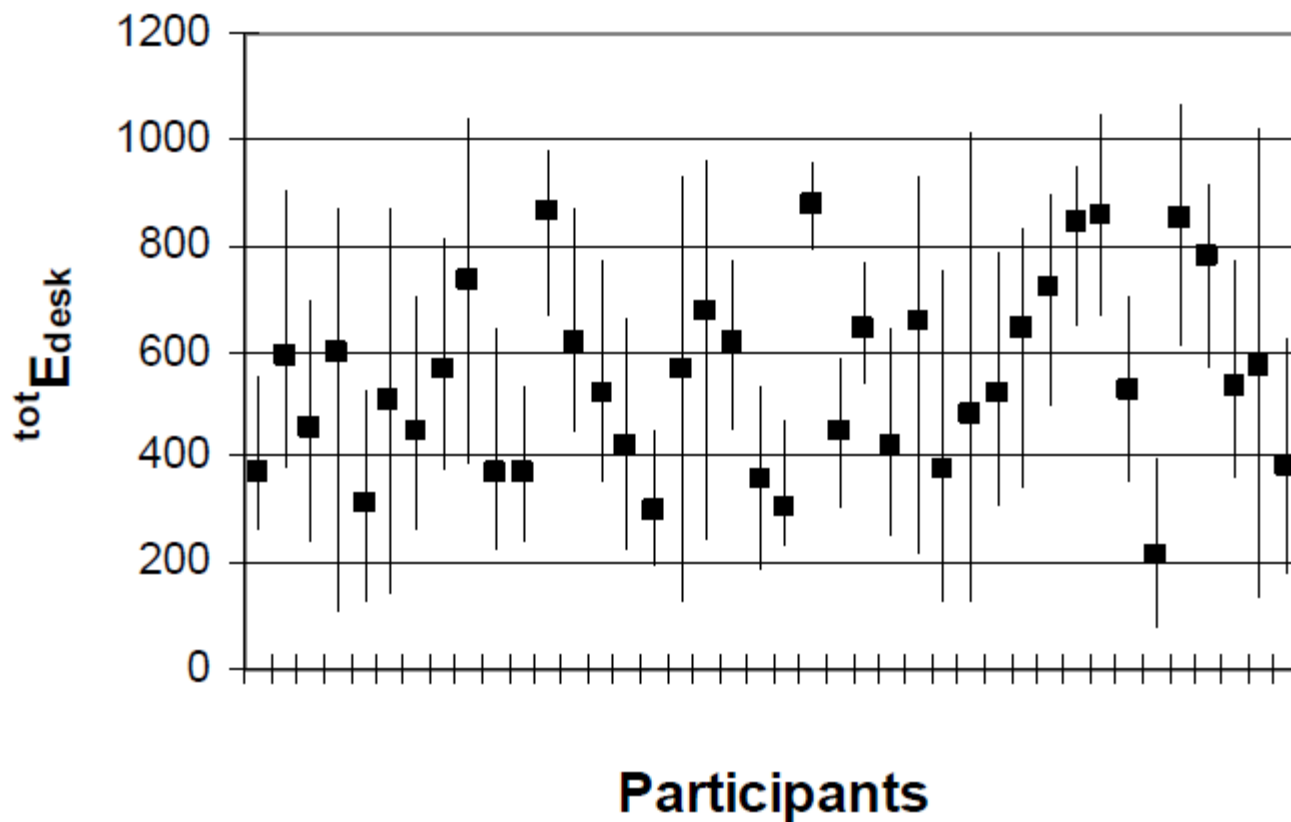
¹ VonNieda B, Maniccia D, & Tweed A. 2000. An analysis of the energy and cost savings potential of occupancy sensors for commercial lighting systems. Proceedings of the Illuminating Engineering Society. Paper #43.

² Galasiu AD, et al. 2007. Energy saving lighting control systems for open-plan offices: A field study. Leukos. 4(1) pg 7-29.

³ Reinhart CF. 2002. Effects of interior design on the daylight availability in open plan offices. Study of the American Commission for an Energy Efficient Environment (ACE) Conference Proceedings. To achieve maximum lighting savings, automated shades are utilized.

What's the value of controls?

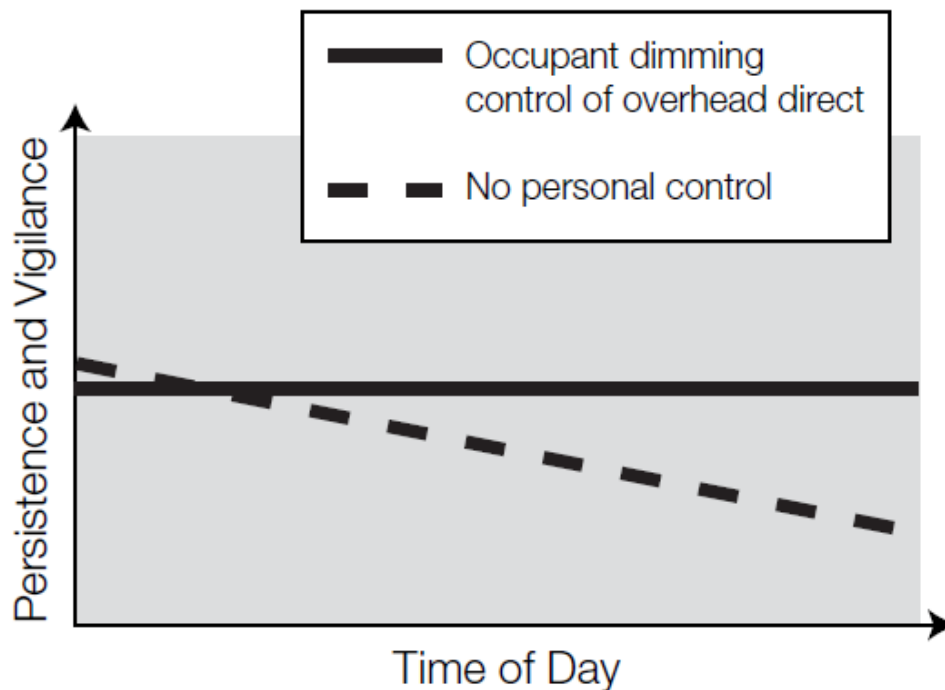
Light Level Preference



Source: www.lighthouseconsortium.org (Pacific Northwest National Laboratory)

What's the value of controls?

Lighting Control and Productivity



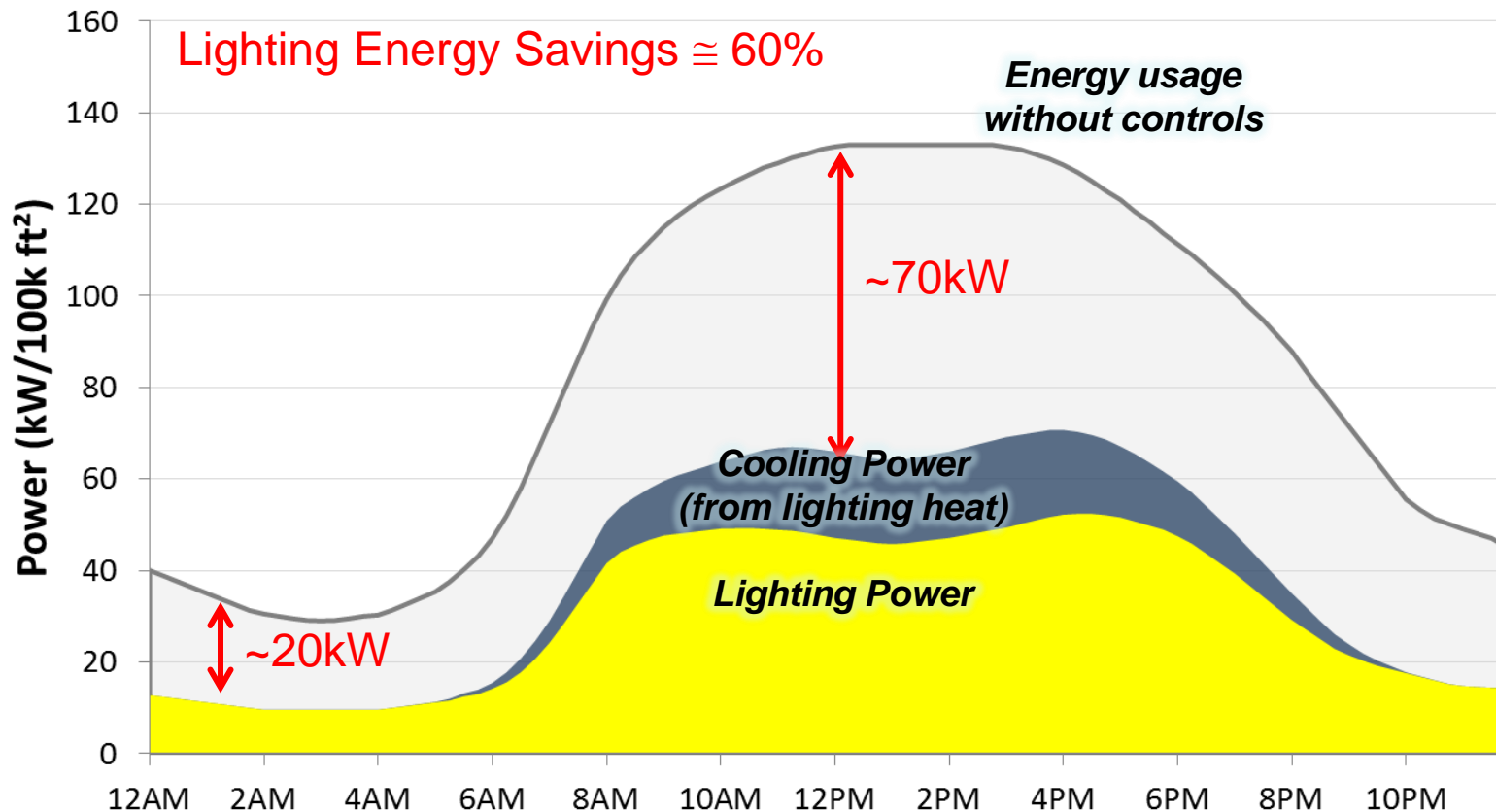
Note: Even a 1% Productivity increase provides \$2 per ft² of annual savings¹

Source: Newsham GR, et al. 2008. Individual control of electric lighting in a daylit space. Lighting Research and Technology. 40(1) pg. 25-41.

¹ Assumes \$200/ft² annual salary plus benefits

Peak savings versus energy savings

Using Dimming Lighting Controls



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

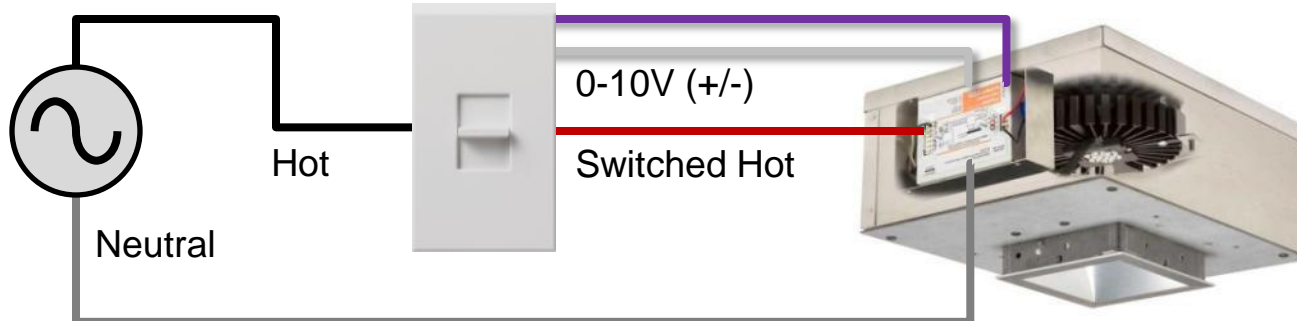
- Phase Control

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



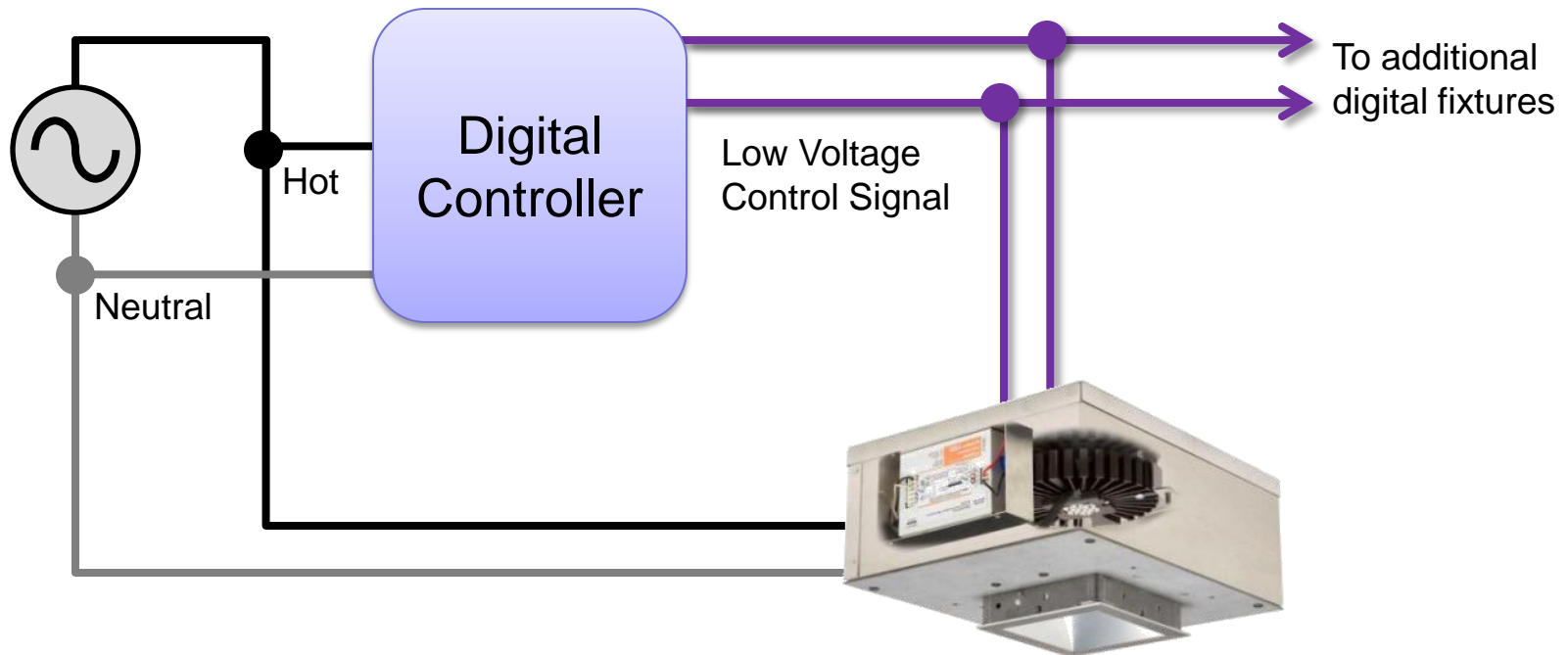
- 0-10V

- Developed for ballasts, exhibited a resurgence due to LEDs
- Prone to interference and occasional compatibility problems



Digital wired technologies

- DMX
- DALI and derivatives (EcoSystem)

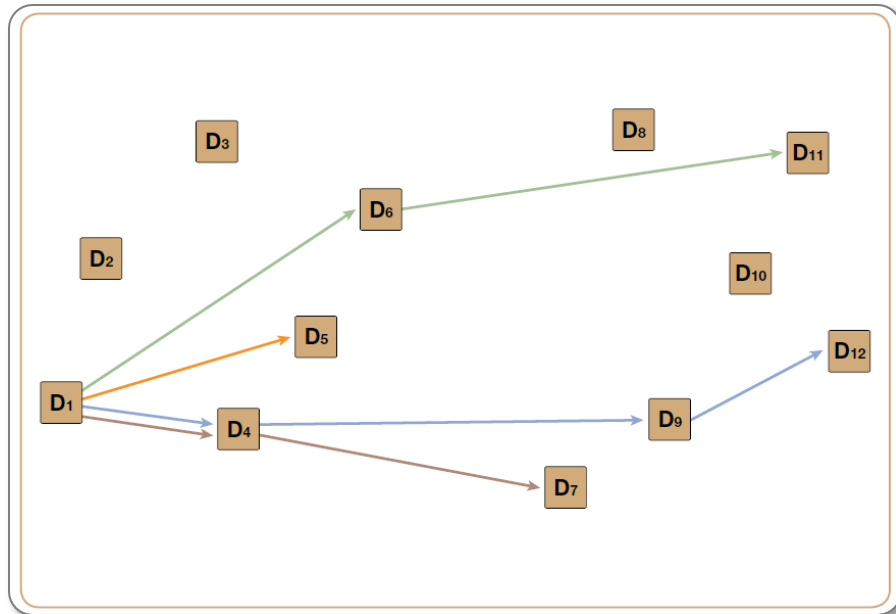


Common wireless technologies in lighting

- ZigBee
- Z-Wave
- WiFi
- Bluetooth
- Manufacturer-specific
 - ClearConnect
 - SmartCast

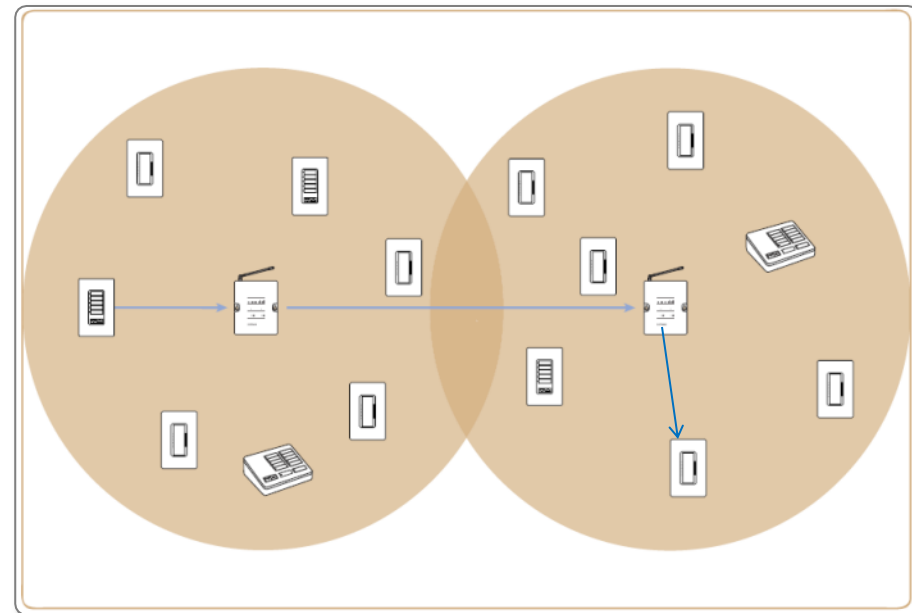


Mesh vs. fixed wireless networks

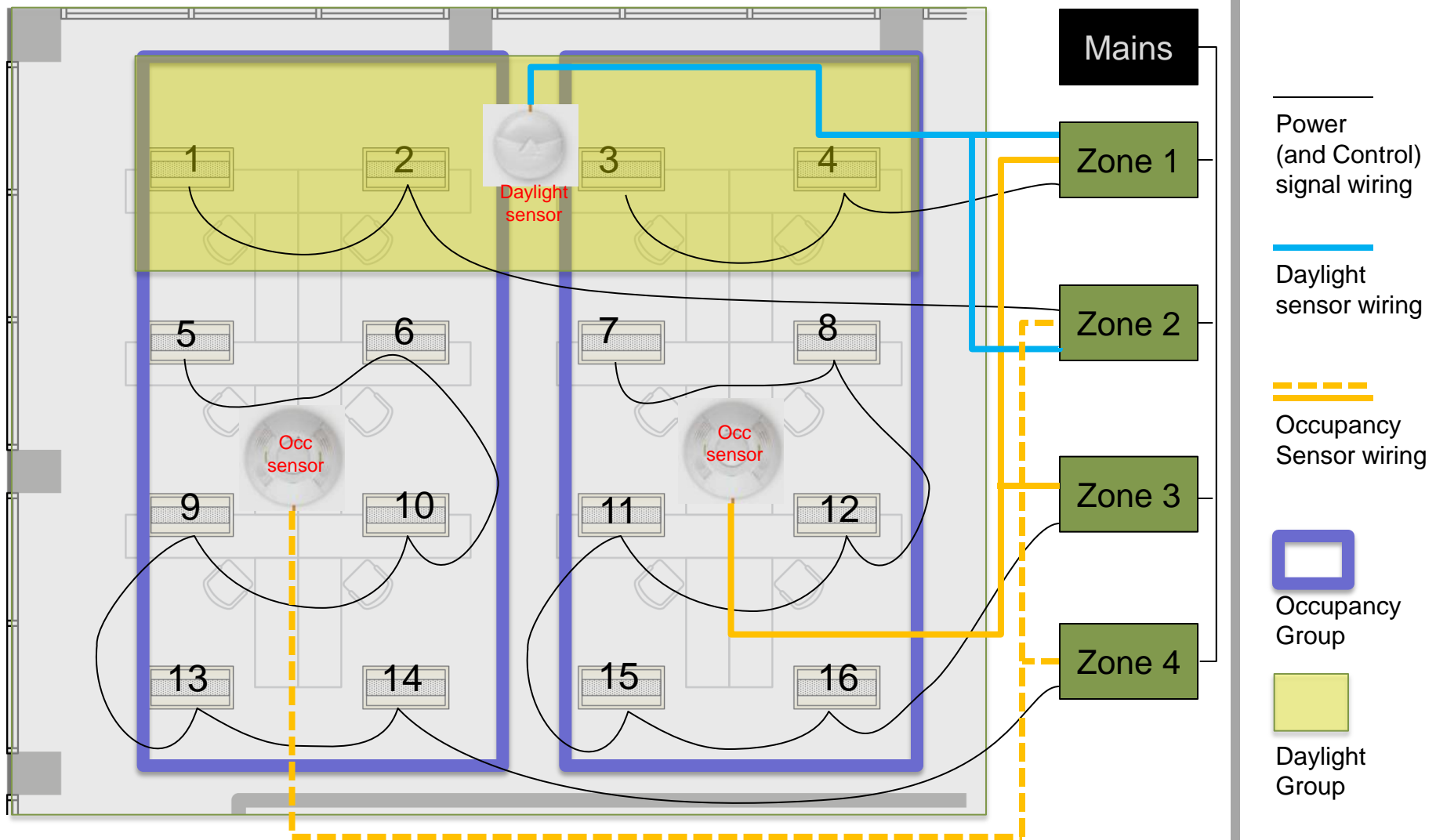


Fixed network: messages take a predetermined path through dedicated devices, established at network commissioning

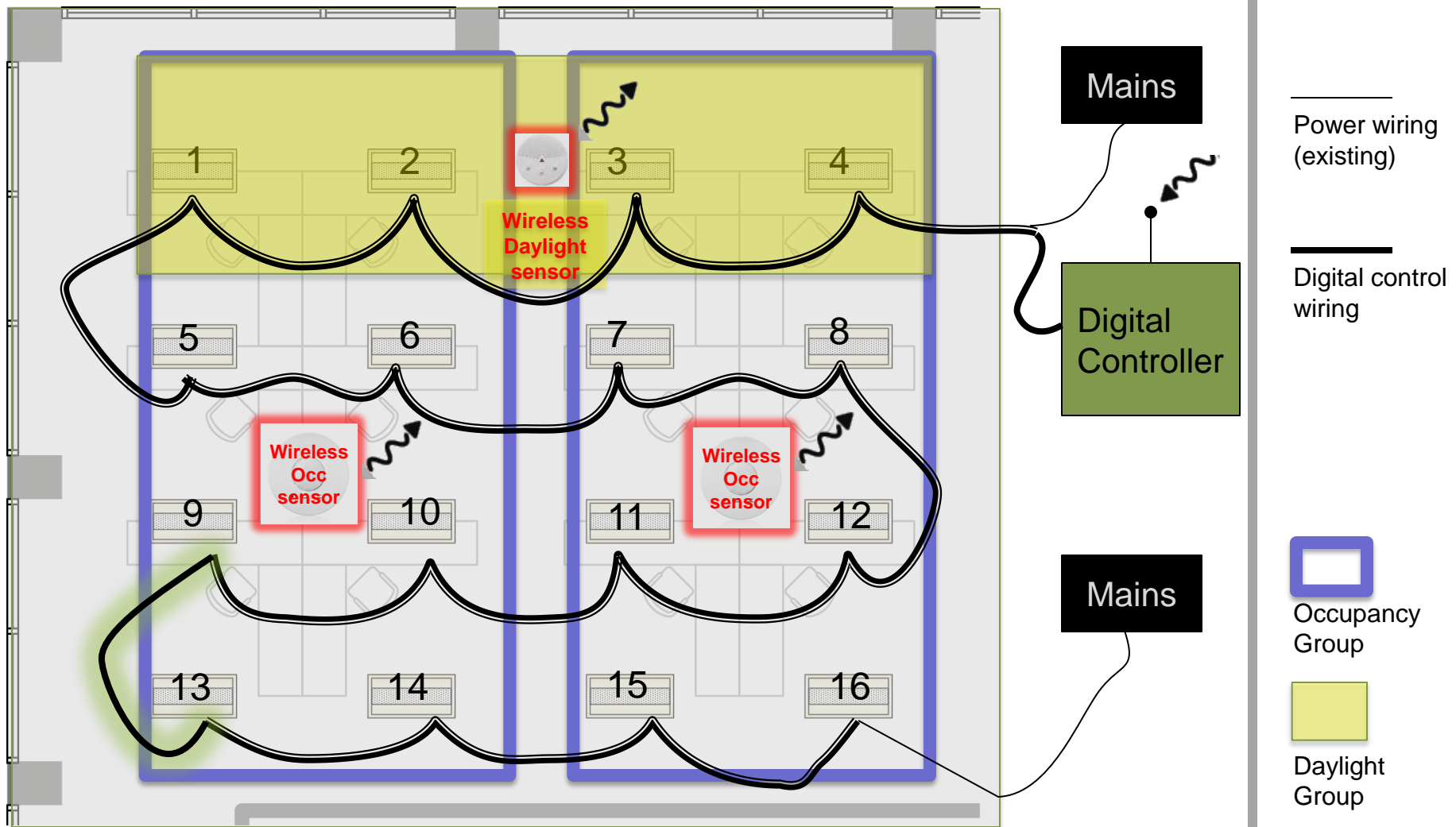
Mesh network: messages take a varying path through other devices, based on network-established routing metrics



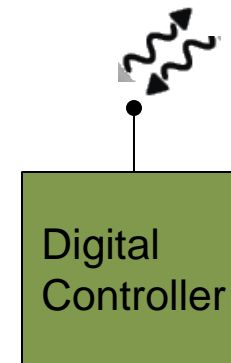
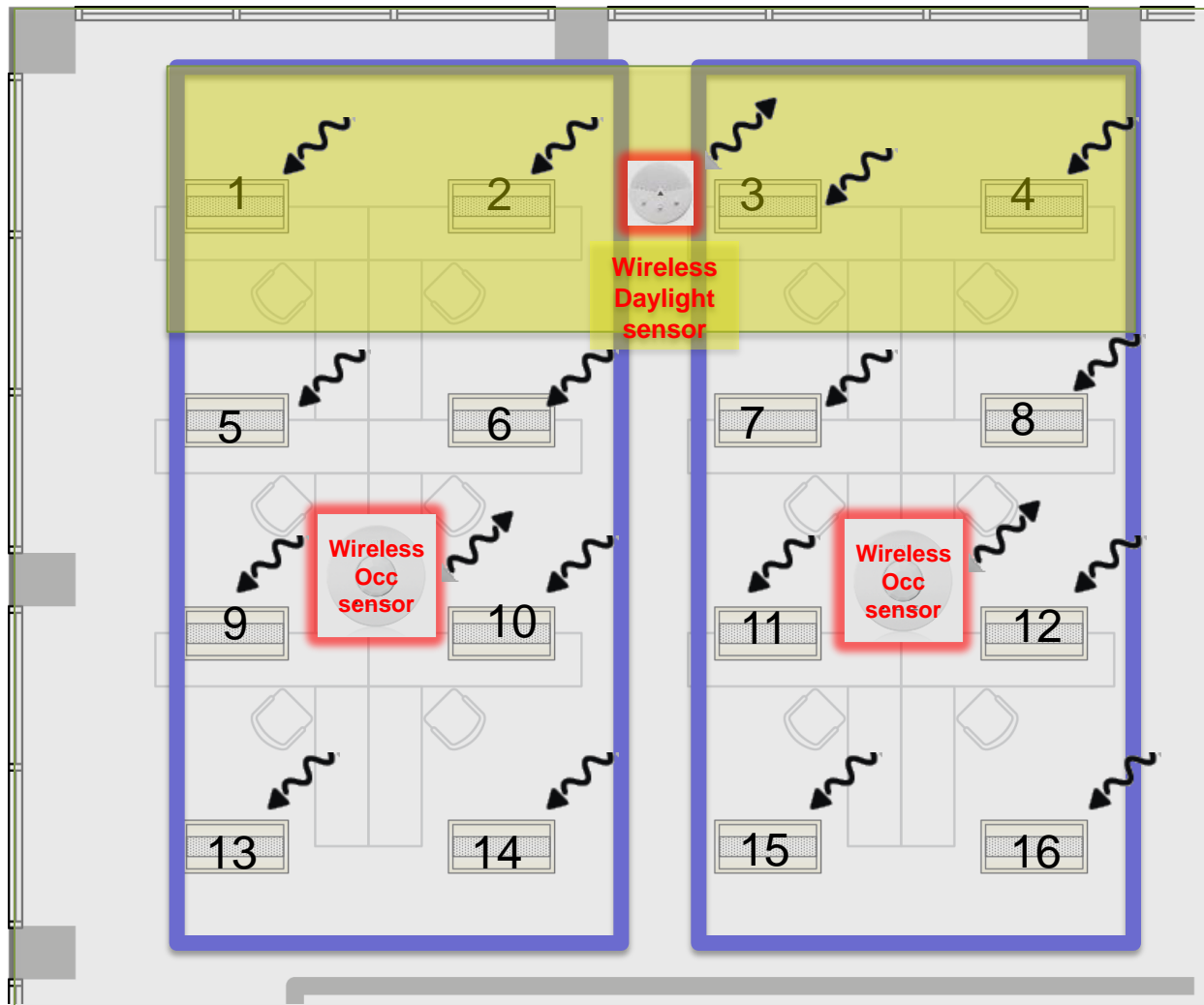
Control in the analog world



Control in the digital world: wired



Control in the digital world: wireless



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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