



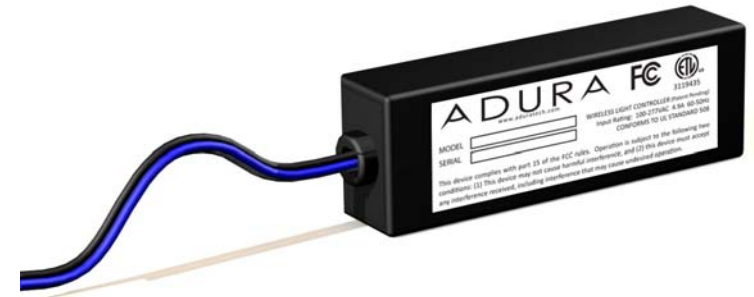
Project 6: Wireless Integrated Photo and Motion Sensor (WIPAM) Lighting Control System



February 21, 2008

Adura Technologies

- Who we are
 - Founded in 2005
 - UC Berkeley technology
- Our mission
 - Enable low-cost lighting management
 - Focus primarily on existing buildings
- The product we have already developed
 - LightPoint
 - Wireless tactile switches (beta)



WIPAM Overview

- Objective:
 - Wireless mesh network communication with photo and motion sensors
- Motivation:
 - Wired lighting control systems can be expensive
 - Integrating photo and motion sensing allows for more energy savings
- Project outcomes:
 - Working demonstration of WIPAM system at various sites
 - Commercialization of the technology

Current Activities

- Since October PAC meeting ...
- Performed market analysis of potential market size, possible energy savings, and payback period
- Identified initial target environments for WIPAM, wireless photo sensing, and wireless motion sensing
- Developed product specifications for initial target applications
- Identified potential demonstration sites for photo sensing and motion sensing applications

“The Matrix”: Market Model for WIPAM

- ***For each CEUS building type sector:***
- **Inputs:**
 - California floor stock (CEUS 2006)
 - Interior lighting electricity costs (CEUS 2006)
 - Estimated energy savings resulting from WIPAM
- **Assumptions:**
 - Interior space types within each building category
 - Occupancy and lighting characteristics for each building category
 - Penetration of existing motion and photosensors
- **Outputs:**
 - Addressable California floor stock for each type of control
 - Estimated annual energy savings (\$/sq.ft.)
 - Estimated payback period (years)

Matrix Results and Findings

- Payback:
 - At \$0.14/kWh electricity price and \$0.75/sq. ft. installed cost (our product target), most applications show *2-5 years payback* WITHOUT counting utility rebates, state incentives and federal tax incentives
- Addressable Markets in California:
 - Motion: 41.5% of commercial floor stock / 2.04 billion sq. ft.
 - Photo: 7.2% of floor stock / 355 million sq. ft.
 - WIPAM: 11% of floor stock / 540 million sq. ft.
 - These markets are overlapping to some extent

Matrix: Reality Check Issues

- Variance in Energy Savings
 - Savings potential will vary dramatically between buildings – how much % energy saving can we estimate overall?
 - We have heard about 30% savings from motion sensors and up to 80% savings with daylight sensors
- Sectors with highest energy density will have the best payback periods, but may also be most resistant to lighting controls:
 - Top 3 payback periods: Retail, Restaurant, Food Store
- Installed Hardware:
 - Bi-level fixtures – Our system can take advantage of bi-level fixtures to add more lighting configurations, e.g., multi-level occupancy, step dimming
 - HID – not ideal for switching in some environments; newer ballasts may offer multi-level switching
- Warehouses – how much available daylight area to assume? How will T24 2008 affect market?

Initial Target Environments

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- **Wireless Motion Sensor – Corridors**
 - Energy savings potential during “off-peak” times
 - Potential to use step dimming / bi-level illumination
 - **Wireless Photo Sensor – Parking Structures / Areas**
 - Copious daylight in CA, no issues of distracting occupants
 - Major advantage of wireless for retrofit
 - **WIPAM – Personal Offices**
 - Linking daylighting and occupancy controls to provide greatest energy savings
 - Intelligent step dimming is an option, multiple possible control scenarios (e.g., automatic-on vs. manual-on)

Use Scenarios & Product Spec

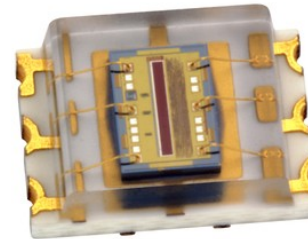
- Characterized each target environment, making assumptions about the following:
 - Occupant preferences, expectations, tasks
 - Environmental conditions, building materials
- Developed use case scenarios for installation, use, and maintenance
- Derived initial product specification from these exercises

Summary of WIPAM Control Logic


- Light controller turns **OFF** controlled lighting in daylit area when:
 1. Photo sensor illumination is high (OFF setpoint)
OR
 2. Personal controls switched on
OR
 3. Motion detection times out (no motion within time delay)
- Light controller turns **ON** controlled lighting in daylit area when:
 1. [Photo sensor illumination is low (ON setpoint)
AND
 2. Motion has been detected within time delay]
OR
 3. Personal controls switched off
OR
 4. All sensor "heartbeat" messages have timed out ...
the controller reverts to manual (non-sensing) operation

Sensor Prototyping

- Currently engaged in developing wireless sensor prototypes based on our existing wireless platform
- TAOS 2561 Digital dual photodiode sensor
- PerkinElmer PIR (dual element) with digital output board



Next Steps

- 
- Continue prototype development
 - Implement early control algorithms
 - Evaluate housing and mounting options for sensors


Advisor Feedback Sought

- Base Cases:
 - Validation of target environment assumptions and use cases
- WIPAM Product Specification:
 - Feedback on initial product specification
 - Feedback on general control logic
- Market Matrix:
 - Insight into reality check issues
- Matrix, product spec, target environment characterizations and use cases all available in draft report on AEC webpage

Thank You!

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CEUS 2006 Data



	Floor Stock (kft ²)	Interior Lighting Electric Energy Intensities (kWh/ft ² -yr)
Small Office (<30k ft ²)	361,584	3.83
Large Office (≥30k ft ²)	660,429	4.46
Restaurant	148,892	6.45
Retail - Largest end-user of lighting (53.7%)	702,053	6.05
Food Store	144,209	8.55
Refrigerated Warehouse	95,540	2.74
Unrefrigerated Warehouse	554,166	2.21
School	445,106	2.88
College	205,942	3.84
Health	232,606	4.81
Lodging	270,044	3.50
Miscellaneous	1,099,544	2.61
Totals & Averages	4,920,115	4.33

Matrix: Addressable Floor Space in CA



Addressable Floor Space	Motion Sensing	Light Level Switching	WIPAM
	Total (kft2)	Total (kft2)	Total (kft2)
Small Office (<30k ft ²)	118,920.46	14,463.36	43,390.08
Large Office (≥30k ft ²)	200,762.16	26,417.16	69,345.05
Restaurant	39,236.76	19,355.96	20,844.88
Retail - Largest end-user of lighting (53.7%)	219,467.01	91,266.89	98,287.42
Food Store	45,080.81	18,747.17	20,189.26
Refrigerated Warehouse	60,464.88	-	-
Unrefrigerated Warehouse	350,717.81	-	-
School	139,462.84	62,314.84	71,216.96
College	82,042.85	24,713.04	29,861.59
Health	86,229.46	13,956.36	37,216.96
Lodging	107,579.70	10,801.76	40,506.60
Miscellaneous	593,203.99	73,302.93	109,954.40
Totals & Averages	2,043,168.72	355,339.47	540,813.20

41.53%

7.22%

10.99%