Welcome

Conservation Applied Research & Development (CARD) Webinar

April 13, 2022
Power over Ethernet (PoE): What are the Benefits?
Power over Ethernet (PoE): What are the Benefits?

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Webinar Basics

• Attendees in listen-only mode
• Type questions into Q&A box
• Send to “All Panelists”
• Questions addressed at end
• Webinar recorded & archived
• Slide set will also be available

Q&A on right side of WebEx panel
Type Questions in Q&A box
Send Questions to All Panelists

Additional WebEx Controls at Bottom of Your Screen
Minnesota Applied Research & Development Fund

• Purpose to help Minnesota utilities achieve 1.5% energy savings goal by:
  • Identifying new technologies or strategies to maximize energy savings;
  • Improving effectiveness of energy conservation programs;
  • Documenting CO₂ reductions from energy conservation programs.

  Minnesota Statutes §216B.241, Subd. 1e

• Utility may reach its energy savings goal
  • Directly through its Conservation Improvement Program (CIP)
  • Indirectly through energy codes, appliance standards, behavior, and other market transformation programs
CARD RFP Spending by Sector thru FY2020

**RFP Summary**
- 12 Funding Cycles
- 513 proposals
- 143 projects funded
- $31.2 million in research
Agenda

- Research Objectives
- Introduction of PoE Technology
- Site Demonstrations
- Concluding Remarks
Research Objectives

1. Assess the receptiveness of commercial and institutional markets to these new technologies.
2. Demonstrate the feasibility of PoE technologies within standard design/construction practices and commercial codes.
3. Assess the energy and cost savings opportunities of these technologies.
4. Provide energy management opportunities where they typically are not available.
5. Formulate approaches to spur adoption of these technologies in the marketplace.
Power over Ethernet (PoE) Devices
Network Switches
Ethernet Cabling
Networked Computers
Cat 5e/6a Ethernet Cables
One Cable, Two Purposes

Some wires transfer power

Some wires transfer data

eight wires = four twisted pairs
# PoE Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Maximum power allowed in PSE</th>
<th>Power available to end device</th>
<th>Applications of PoE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2003</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PoE 802.3af</td>
<td>15.4 W</td>
<td>12.95 W</td>
<td>Phones, Wireless access points</td>
</tr>
<tr>
<td><strong>2009</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PoE+ 802.3at Type 2</td>
<td>30 W</td>
<td>25.50 W</td>
<td>LCD displays, HVAC controllers/sensors</td>
</tr>
<tr>
<td><strong>2017</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UPoE 802.3bt Type 3</td>
<td>60 W</td>
<td>51 W</td>
<td>LED lighting, Thin client computers, Smart building devices</td>
</tr>
<tr>
<td><strong>2019</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher-power PoE 802.3bt Type 4</td>
<td>100 W</td>
<td>71 W</td>
<td>Laptops and TVs, LED bay lighting, Mini Fridges</td>
</tr>
</tbody>
</table>
## Comparison of AC and PoE Lighting Systems

<table>
<thead>
<tr>
<th>Power (in Watts)</th>
<th>AC-Powered Suspended Fixture with Ballast</th>
<th>Signify PoE Suspended Fixture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T8 Lamps</td>
<td>LED Lamps</td>
</tr>
<tr>
<td>Load per Fixture</td>
<td>58</td>
<td>26</td>
</tr>
<tr>
<td>Standby</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
PoE All-in-One Workstation

<table>
<thead>
<tr>
<th>Cubicle Workstation</th>
<th>Computer Power Load (in Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Activity</td>
</tr>
<tr>
<td>PC computer with two external monitors</td>
<td>40 - 95</td>
</tr>
<tr>
<td>ThinLabs AiO computer</td>
<td></td>
</tr>
<tr>
<td>with dual monitors</td>
<td>AC-Powered</td>
</tr>
<tr>
<td></td>
<td>PoE</td>
</tr>
</tbody>
</table>
## PoE Thin Client

<table>
<thead>
<tr>
<th></th>
<th>Hewlett-Packard Thin Client</th>
<th>10ZiG Thin Client</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average (in Watts)</strong></td>
<td>9 - 18</td>
<td>5 - 12</td>
</tr>
<tr>
<td><strong>Standby (in Watts)</strong></td>
<td>0 – 1.0</td>
<td>0.5 - 0.7</td>
</tr>
</tbody>
</table>
Edina Middle School Classroom Lighting

Classroom with PoE LED Lighting System

Classroom with Line Voltage LED Lighting System
Classroom Floor Plan
PoE vs. Line Voltage Power Draw

Average Lighting Level (lux) vs. Power Draw (W)

- **POE @ 4000K**

  \[ y = 2.6245E-04x^2 + 7.6871E-01x + 5.0000E+01 \]

- **LineV @ 4000K**

  \[ y = -1.3950E-04x^2 + 8.4838E-01x \]
Power Profile (Winter vs. Spring)
Effective Power vs. Lighting Level

<table>
<thead>
<tr>
<th>Lighting Level</th>
<th>% Effective Power of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>25%</td>
<td>61%</td>
</tr>
<tr>
<td>75%</td>
<td>79%</td>
</tr>
<tr>
<td>100%</td>
<td>79%</td>
</tr>
</tbody>
</table>

Power (W)

Effective power
- Light fixtures
- Non-effective power
- Nodes
- Other
District Media and Technology Services (DMTS) Offices (pre-retrofit)
### District Media and Technology Services (DMTS) Offices (after renovation)

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Lighting Power Load (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T8</td>
<td>1850</td>
</tr>
<tr>
<td>PoE with 75% brightness</td>
<td>318</td>
</tr>
<tr>
<td>PoE with customized brightness</td>
<td>167</td>
</tr>
</tbody>
</table>
Atwater-Cosmos-Grove City Junior-Senior High School
Grove City, MN

The remodel of the ACGC Admin Offices were outfitted with multiple PoE systems:
- PoE lighting system
- PoE VAV controllers
- PoE AV system controller

The PoE systems are compared with:
- AC-powered DALI networked lighting system
- AC-powered VAV controllers
- AC-powered AV system controller
PoE Lighting System Power Draw
PoE Lighting System – Network Switches
PoE Lighting System – Network Servers
PoE Lighting System – Sensors and Controls
DALI Lighting System Power Draw
DALI Lighting System
DALI Lighting System - Controller
DALI Lighting System – Network Gateway
DALI Lighting System – Sensors, Wall Switches & Ballasts/Drivers
## Comparison of Lighting Systems

<table>
<thead>
<tr>
<th>Location</th>
<th>Edina South View Middle School</th>
<th>ACGC School District</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>Classroom 1</td>
<td>Classroom 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jr-Sr High School</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Admin Offices</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elementary School</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Admin Offices</td>
</tr>
<tr>
<td>Lighting System</td>
<td>PoE lighting system</td>
<td>AC LED lighting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PoE lighting system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DALI system</td>
</tr>
<tr>
<td>Fixtures</td>
<td>16 – 2x2 troffers</td>
<td>12 – 2x4 troffers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>59 – 2x2 troffers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22 – 4’ linear lights</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 – 4” downlights</td>
</tr>
<tr>
<td></td>
<td>22 – 4’ linear lights</td>
<td>15 – 2x2 troffers</td>
</tr>
<tr>
<td></td>
<td>1 – 4” downlights</td>
<td>5 – 2’ linear lights</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 – 4” downlights</td>
</tr>
<tr>
<td>Power Draw</td>
<td>469 W</td>
<td>368 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1687 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000 W</td>
</tr>
<tr>
<td>Power/Fixture</td>
<td>29 W</td>
<td>30 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48 W</td>
</tr>
<tr>
<td>Baseload/fixture</td>
<td>3.1 W</td>
<td>0.3 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.2 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.8 W</td>
</tr>
</tbody>
</table>
Current Demonstration Sites - SPPA

Saint Paul Port Authority
Treasure Island Center
Saint Paul, MN

The new SPPA offices have:
- PoE networked lighting system
- PoE controlled outlets
- AV system controls
- VAV controllers.
Current Demonstration Sites – The Sinclair

The Sinclair
Marriott Autograph Collection
Fort Worth, TX

The Sinclair Building, originally constructed in 1929, has been converted into a Marriott Autograph Collection 16-story luxury hotel.

Retaining its Art Deco feel and décor, the building has been converted into a DC-powered building.
The Sinclair
DC Electricity in The Sinclair

Voltserver
Digital Electricity
High Voltage DC

Power over Ethernet
Cisco UPoE
Low Voltage DC
DC Distribution and PoE PDs

Line voltage (from Oncor) → Digital Electricity (Voltserver) → Network Switch (Cisco CDB-8U)

- High voltage AC (120VAC)
- High voltage DC (336VDC)
- Low voltage DC PoE (44-57 VDC)

Devices:
- Lights (NuLEDs)
- Occupancy (Ivani)
- Window Shades (Somfy)
- Television (LG)
- Bath Mirror (electric Mirror)
- Mini Bar (Dometic)
- Door Lock (Assa Abloy)
Concluding Remarks

1. The primary efficiency gain of the powered device (PD) depends on the technology used to provide the end use (e.g., LED lamps for lighting).
2. The efficiency gain from eliminating the AC to DC conversion at the PD is nominal but can add up with scale.
3. The switches, gateways, and servers that are fundamental to PoE systems incur a baseload power cost and standby loads. AC-powered DALI lighting systems have a similar baseload.
4. IP-addressable PDs allow individual device control, two–way communication, and submetering through the network switch.
5. The PoE devices being on the local area network (LAN) allows integration with other building systems such as HVAC, fire/safety/security, and BAS/EMIS through APIs, BACnet, and SNMP.

Final CARD report will be available Summer 2022.
6. The installation and maintenance costs can be lowered compared to AC powered systems.

7. Use of PoE system brings flexibility to building space use, as tenants can move around certain PoE powered devices more easily and customize the devices to accommodate different space use requirements and occupants’ preference.

8. The responsibilities of facilities, IT, and controls contractors with these networked systems needs to be addressed.

9. PoE offerings and capabilities continue to develop as PoE standards evolve.

Final CARD report will be available Summer 2022.
Power over Ethernet (PoE): What are the Benefits?

Questions?

Send us your questions using the Q&A panel

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CARD Project Resources

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For Webinars use CARD Webinars & Videos Quick Link

For Other research documents use CARD Fact Sheets, Guidelines & Tools Quick Link

Webinar Recording & Final Report available in couple months

R&D Web Page (https://mn.gov/commerce/industries/energy/utilities/cip/applied-research-development/)
Thanks for Participating!

Upcoming CARD Webinars:

• **April 28, 2022**: Franklin Energy - Energy Savings Potential of Networked Lighting Control Systems in Small Business

• **July 13, 2022**: Citizens Utility Board of MN - Analysis of New or Modified Energy Efficiency Programs to Increase Energy Savings of Underserved Populations

Commerce Division of Energy Resources e-mail list sign-up

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