Power Over Ethernet Lighting:

Why the Future Looks Bright for Building Owners

Kevin Baze
Chatsworth Products
Power Business
Development Manager

Stephen Eaves
VoltServer, Inc.
Founder and CEO

Matt Laherty
Platformatics, Inc.
Chief Executive Officer

Mike Siefer
Platformatics, Inc.
Chief Technology Officer

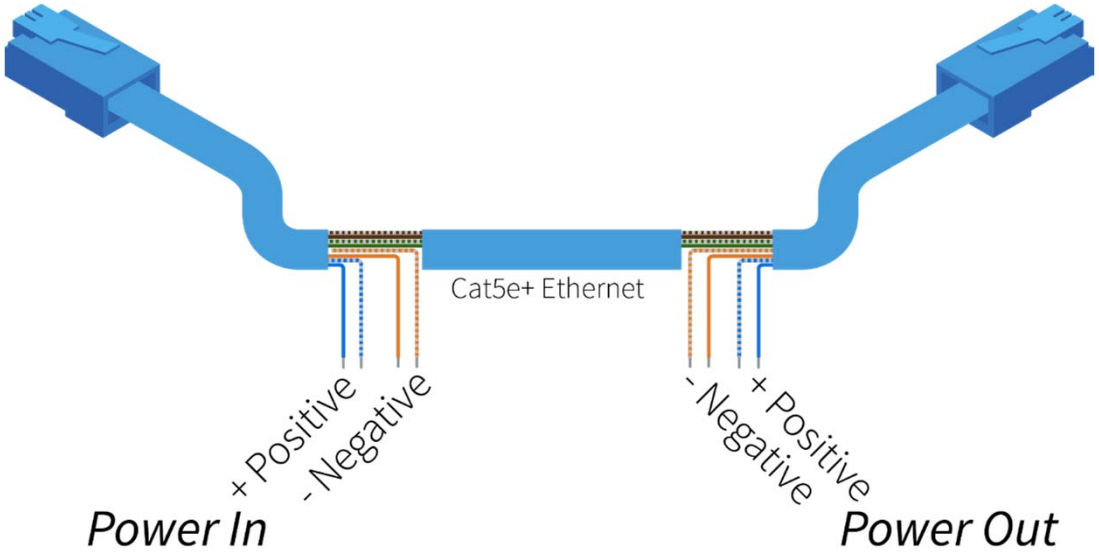
Shane Slater
DMI Technologies
Vice President of
Operations

History of PoE

Learning Objectives

- Understand how Power over Ethernet (PoE) evolved into an IoT application platform
- Understand how to build and install a system
- Understand the limitations
- Understand ELN and Authority Having Jurisdiction (AHJ) topics

PoE Evolution

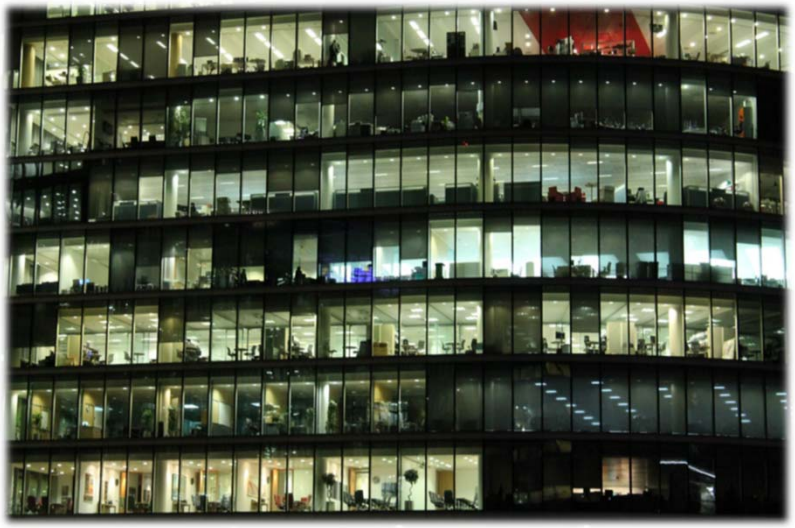


2001	2003	2009	2012	2019
Cisco Inline	IEEE PoE	IEEE PoE+	Cisco UPoE	IEEE PoE
6 watts	15.4 Watts	30 Watts	60 Watts	~70-90 Watts

Why PoE?

- Proven technology
- Global standard
- Flexible platform for multiple apps
- Much lower cost than 277V
- Natural progression of IT
  Similar to voice over IP
- Safe
- Unified infrastructure

The Digital Ceiling is an IoT Platform



Monitor and adjust the environment for better outcomes

- Temperature
- Humidity
- Light level
- CO & CO2
- Gun shot

Improve

- Productivity
- Health
- Comfort
- Safety

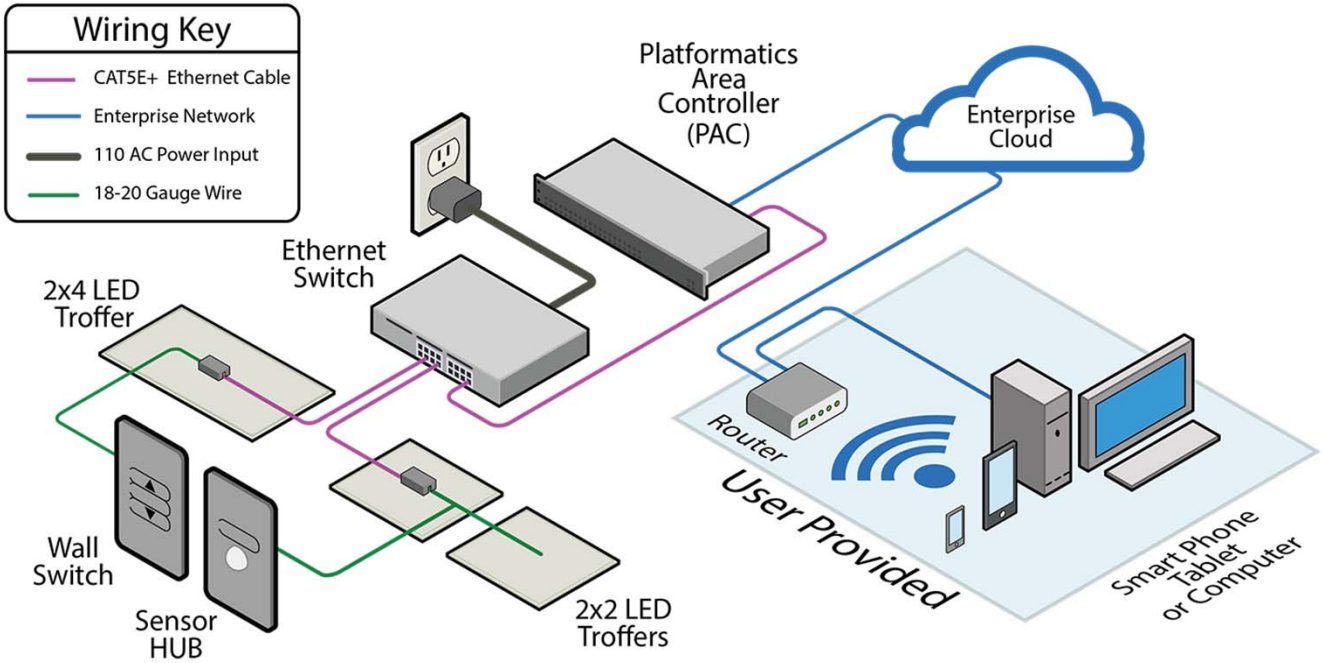
Source: Building Data Book

Why PoE For Lighting?

- Every quality LED fixture works on PoE
- 100 years of fixtures/Edison bulbs work on PoE
- Any emergency light can be monitored and tested in real time
- The system supports hundreds of sensors and critical applications
- PoE is competitive for new construction and deep *retrofit
- PoE costs will be significantly lower than AC power by 2020 with 90 Watt infrastructure

*excluding relamp

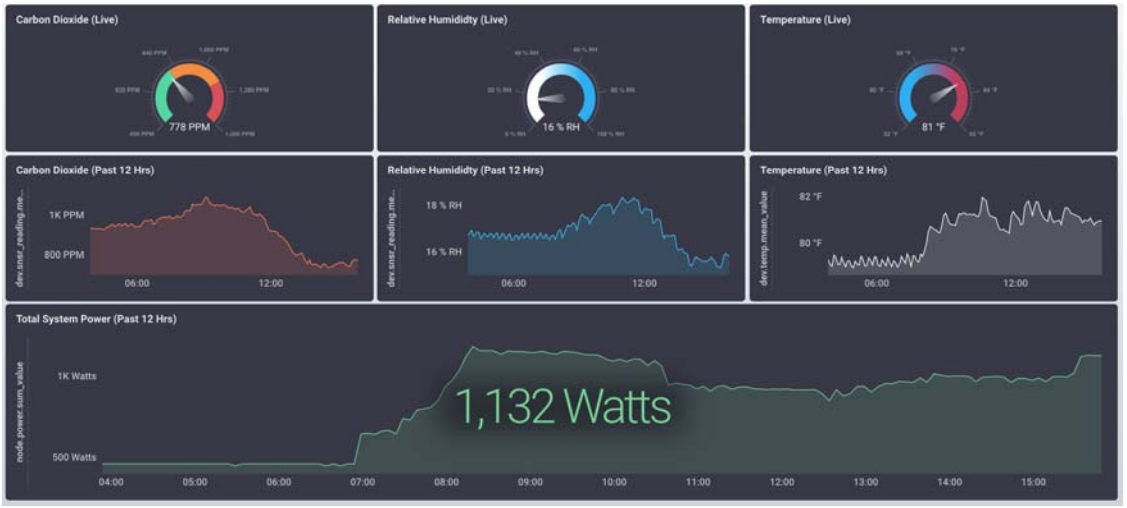
Digital Ceiling Architecture



A Platform for Applications

1. Circadian rhythm scenes keep employees, students and physicians alert
2. Active shooter ensures fast EMS response
3. Color enhances space
4. Emergency light compliance

Make Critical Information Visible



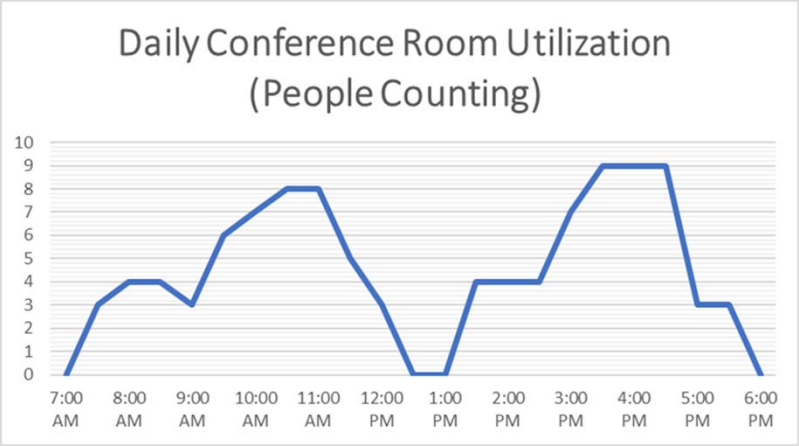
Are employees productive?

If you don't monitor CO2, how do you know?

Is your building efficient?

If you don't monitor power, how do you know?

Conference Room Utilization*

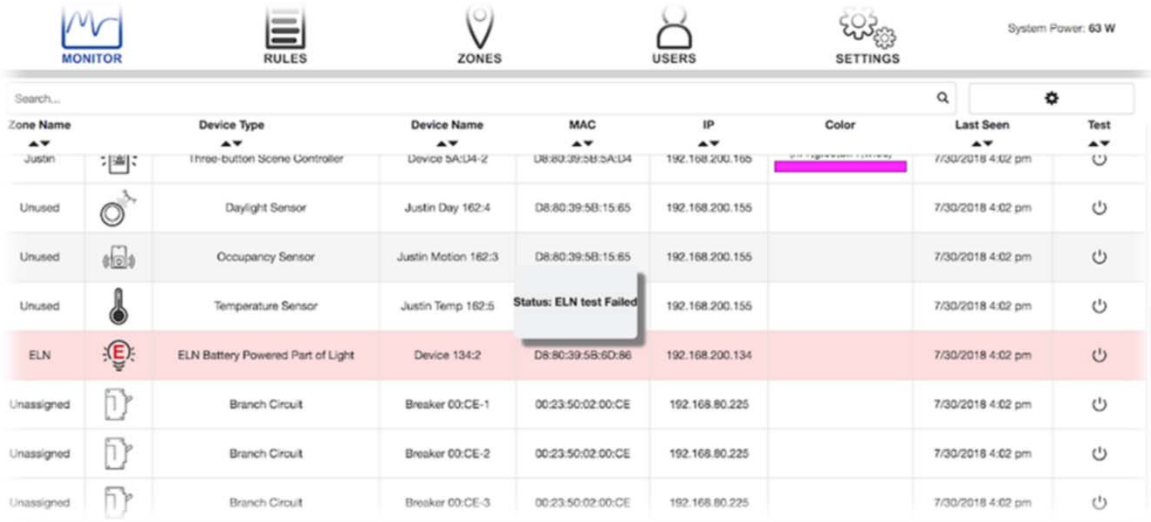


**data collection available in SW 2.0~Sept 2019*

Make Critical Information Visible (Emergency Lighting)

Will your building protect employees when the power dies?

If you don't monitor emergency exit lighting, how do you know?



Actively Monitor Fire Extinguishers

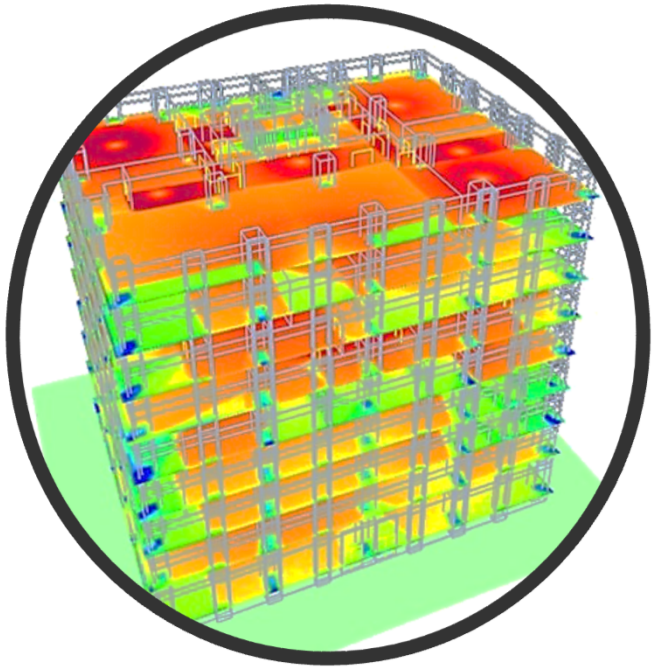
en-Gauge Fire Extinguisher Monitor,

Automate monitoring

- Low pressure
- Removal
- Blocked access
- Eliminate monthly visual inspections

Sensor Meta Data is Converted to Information

- The system can be used for a variety of location-based apps
- Heat maps can be created from a variety of sensors:
  - Temp, humidity, CO2, motion, light, gunshot, fire extinguisher and emergency nodes, etc.
- We provide time-series data through our APIs for third-party applications



Keeping Up With Your Changing Infrastructure

PoE

2017 NEC Limits Cable Bundle Sizes

Table 725.144 Ampacities of Each Conductor in Amperes in 4-Pair Class 2 or Class 3 Data Cables Based on Copper Conductors at an Ambient Temperature of 30°C (86°F) with All Conductors in All Cables Carrying Current, 60°C (140°F), 75°C (167°F), and 90°C (194°F) Rated Cables

	Number of 4-Pair Cables in a Bundle																				
	1			2–7			8–19			20–37			38–61			62–91			92–192		
AWG	Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating		
	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
26	1	1	1	1	1	1	0.7	0.8	1	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	NA	NA	NA
24	2	2	2	1	1.4	1.6	0.8	1	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5
23	2.5	2.5	2.5	1.2	1.5	1.7	0.8	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6
22	3	3	3	1.4	1.8	2.1	1	1.2	1.4	0.7	0.9	1.1	0.6	0.8	0.9	0.6	0.8	0.9	0.5	0.6	0.7

Cat 5e

Cat 6, 6A

Note 1: For bundle sizes over 192 cables, or for conductor sizes smaller than 26 AWG, ampacities shall be permitted to be determined by qualified personnel under engineering supervision.

Note 2: Where only half of the conductors in each cable are carrying current, the values in the table shall be permitted to be increased by a factor of 1.4.

Informational Note: The conductor sizes in data cables in wide-spread use are typically 22–26 AWG.

70 –614 NATIONAL ELECTRICAL CODE 2017 Edition

Source: [NFPA 70, 2017 National Electrical Code](https://www.nfpa.org/NEC/About-the-NEC/Free-online-access-to-the-NEC-and-other-electrical-standards). Used with permission.
https://www.nfpa.org/NEC/About-the-NEC/Free-online-access-to-the-NEC-and-other-electrical-standards

Telecommunications Room Considerations for PoE Lighting

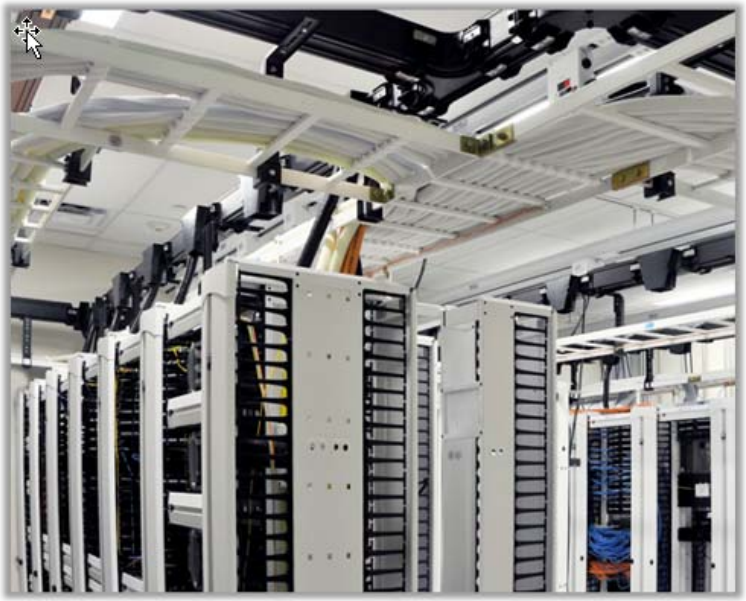
- Dedicated, secure space
- Floor space for additional racks
- Dedicated pathways for PoE structured cabling
- Method of separating cable bundles if necessary
- Power and cooling for additional switches

PoE for Lighting Uses Standard Structured Cabling

- PoE Lighting is distributed on standard structured cabling
- The cabling for lighting is a separate system from the cabling for networking, but it uses the same standards, components and installation practices.
- Use sperate racks for the lighting system and PoE switches/controllers that power the lighting system.
- Reference ANSI/BICSI_007, and ANSI/BICSI_N2

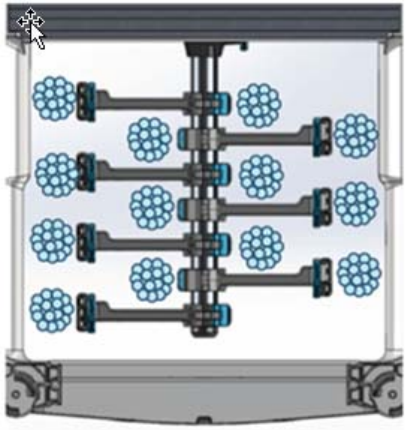
Racks and Cable Management for PoE Lighting

- Two- or Four-Post Racks or enclosures?
  - Size and weight of switches, UPSs
  - Physical Security
- Cable Management
  - Ability to separate bundles
  - Clean install for quick tracing of cables
- Cable Pathway
  - Ability to separate bundles
  - Maintain cable radii in transitions
  - Store service loops

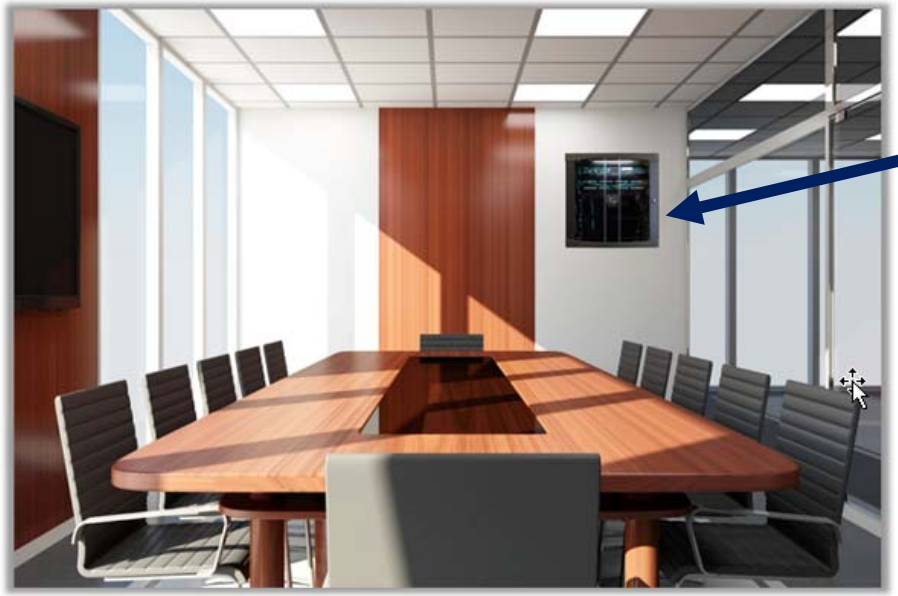


Cable Management Advancements for PoE Lighting

- Enhanced Vertical Cable Management that allows direct support and spacing of cable bundles.



Additional Enclosure Considerations for Public Spaces



- Security
- Safety and reliability
- Cooling without disruption
- Alternative zone cabling options
- Retrofit applications

Implementing PoE Powered Buildings

The Good, the Bad, and the “Not so Pretty”

PoE

Sharing Experience

- What makes PoE lighting installations different?
- What are some things to consider and plan for?
- Where are PoE powered buildings headed?
- What does it take for successful deployments?
- Delivering unique customer value with PoE!

The Rack…

Nothing exciting here…

…or is there?

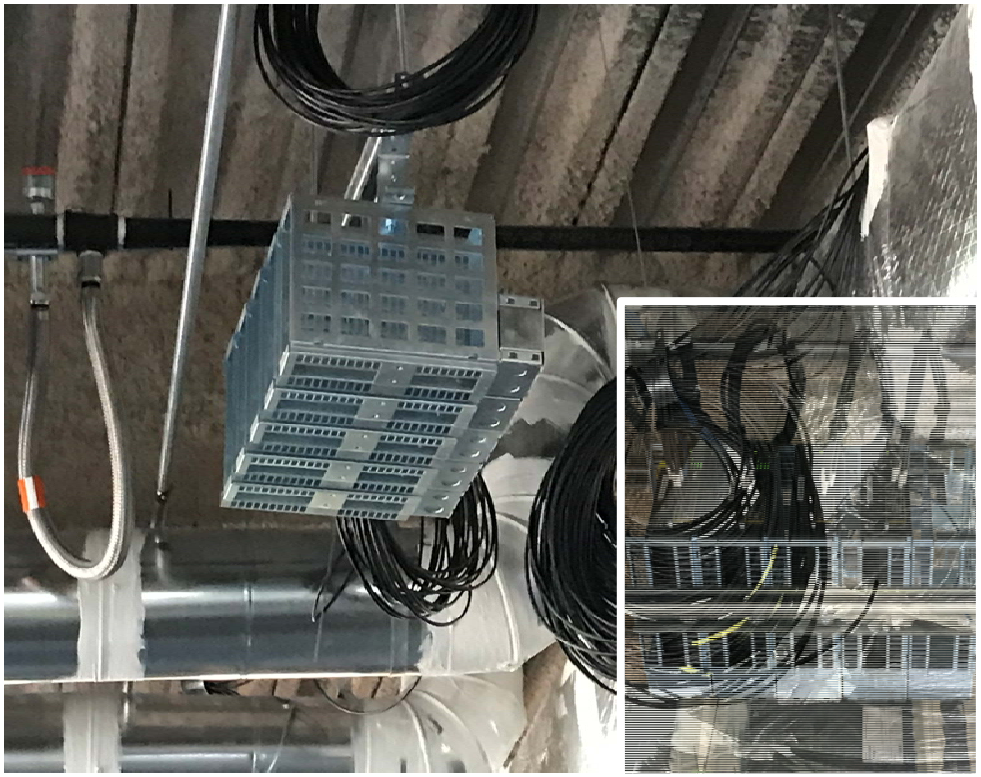
- POWER!
- HEAT!
- FACILITY!

‘Distributed’

The Rack…

Rethink your plan!

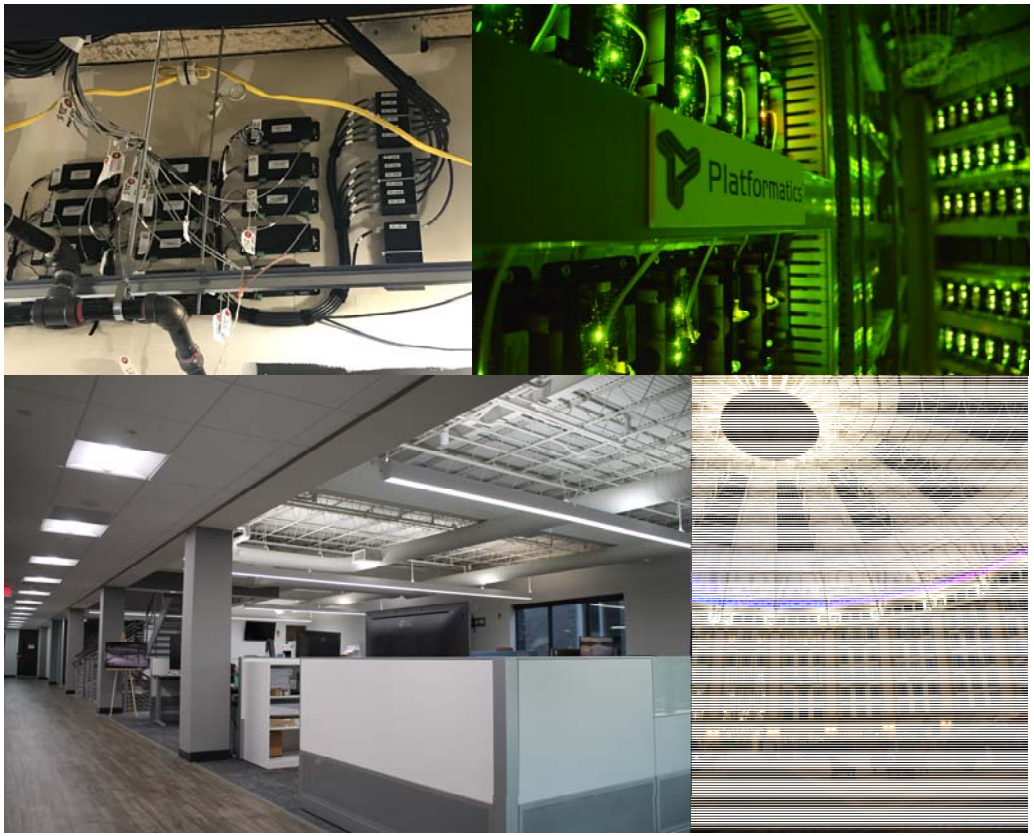
- POWER?
- LOCATION?
- CABLING?



Devices

Placing PoE devices?

- INSTALLATION?
- SERVICEABILITY?
- ASTHETICS?



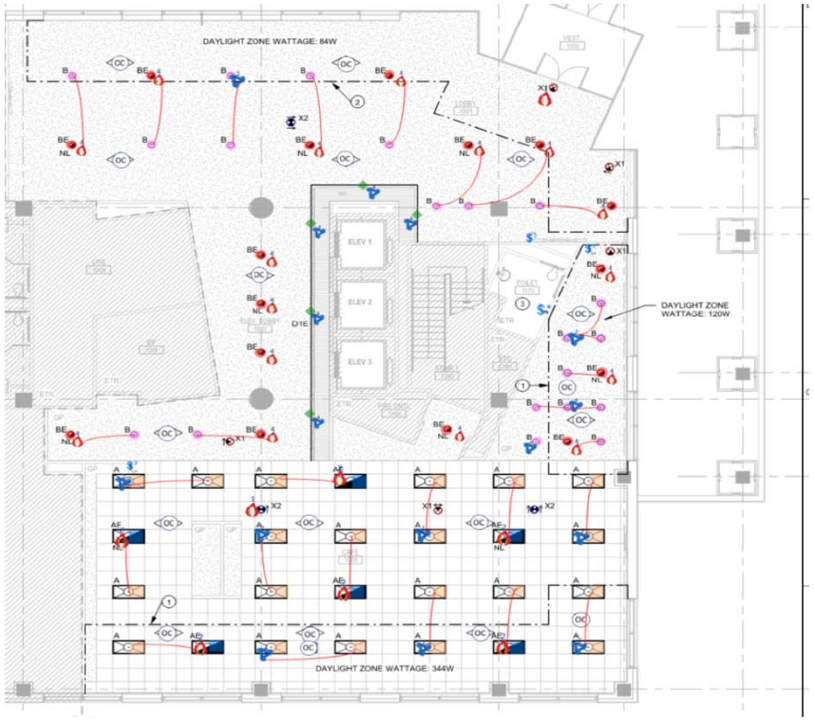
802.3bt

What is it?

- IEEE Standard
- 90W PSE
- PoE Game Changer

Ethernet Alliance – "Overview of 802.3bt – Power over Ethernet standard"
https://ethernetalliance.org/wp-content/uploads/2018/04/WP_EA_Overview8023bt_FINAL.pdf

Plan the Build – Build the Plan



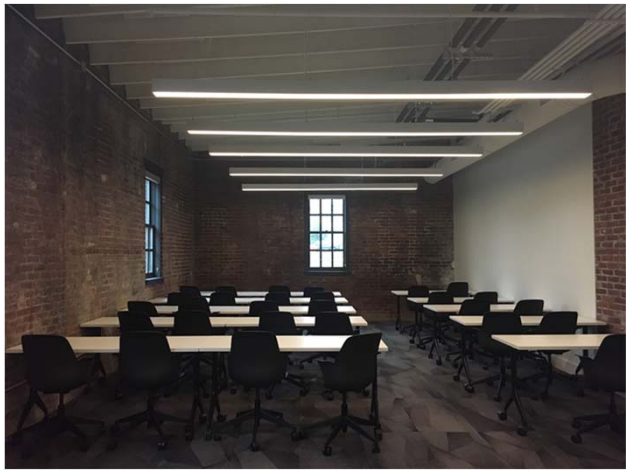
Hardware Legend		
	Description	Quantity
	2 Channel ELN	6
	2 Channel	9
	3BWS	3
	4 Channel	7
	4 Channel ELN	16
	10' White Extension	29
	OCC/VAC SENSORS	18
	WALL SENSOR	1

Start with your RCP

Add icons for:

1. Lights
2. Wall switches
3. Sensors
4. Nodes
5. Emergency exits

Dimension Mill
Co-work Space - Bloomington, IN



Dimension Mill

Project Goals

- Reduce energy use
- Leverage architectural fixtures
- Tunable white workspaces
- Color accent lighting

Challenges and Tips

- Unique fixtures
- Historic building with high tech
- Individually tailored offices
- Special event lighting

BBA Signature Aviation
Global HQ - Orlando, FL

Signature Aviation

Project Goals

- Reduce energy use
- Design for well building (Tunable White Light)
- Include emergency lighting battery packs with remote monitoring

Challenges and Tips

- Demountable walls
- Complete PoE Emergency lighting
- Troubleshooting fixtures

West Baden Hotel, IN

- The system used 170-1000 Watt bulbs
- They wanted to reduce electricity spend and enhance the color show
- Our system typically consumes only 3kw/hr.
- The customer reduced energy by 98%

West Baden Hotel

Project Goals

- Significantly reduce energy use
- Create color light show ‘playlists’
- Remote mount the nodes in a bird coupe on the roof

Challenges and Tips

- From incandescent to high-performance LEDs
- Remote nodes
- Keeping historic aesthetics

…and many more, each providing unique customer value!

Case Study One

The Sinclair Autograph

The Sinclair Autograph: Marriott & CVS

The Sinclair, Autograph Collection by Marriott Hotel in Fort Worth, TX

Everyday Devices Powered by PoE

CVS PoE Installation

- 2-story CVS with all PoE lighting in downtown Fort Worth
- Running for 18 months with no issues
- Cost savings
- Installed by low-voltage contractor

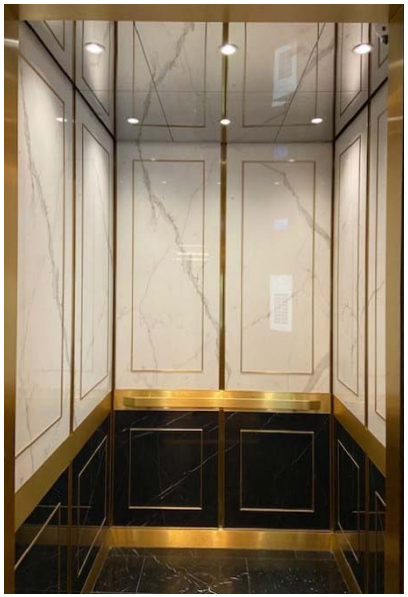
The Sinclair Marriott

16-story historical building with basement restaurant and rooftop bar

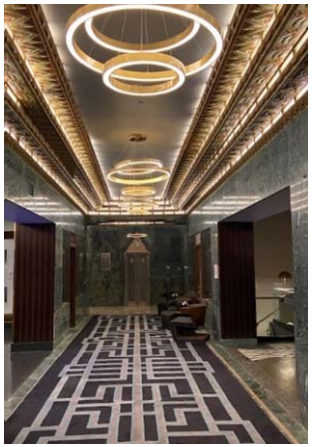
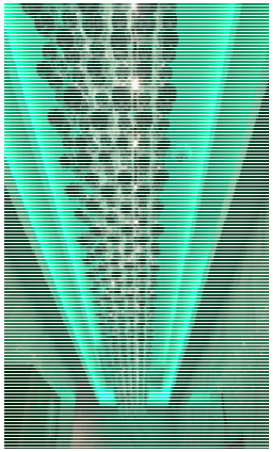
What Is Being Powered by PoE

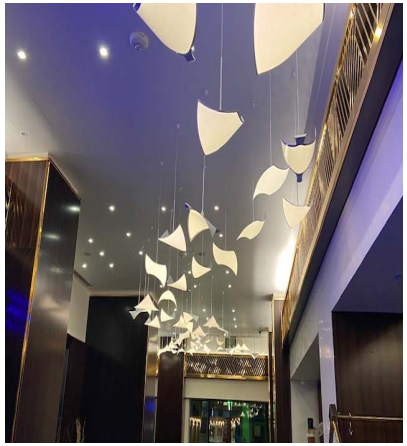
All light fixtures

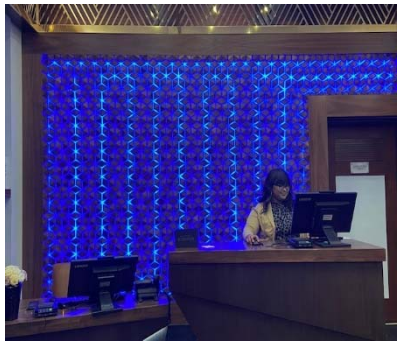


What is Being Powered by PoE

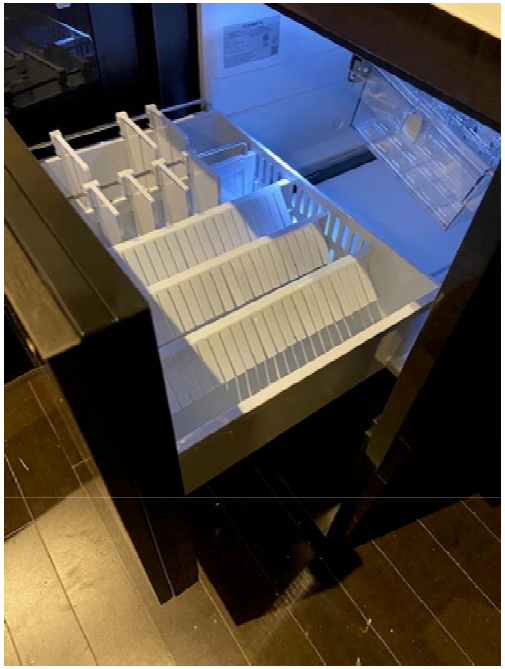





What Is Being Powered by PoE

In-room mini bar

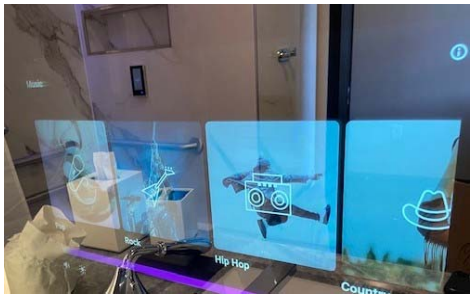


What Is Being Powered by PoE

Somfy shades

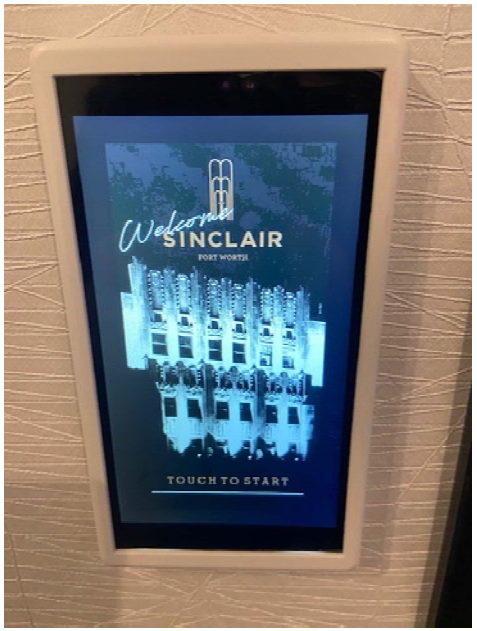
What Is Being Powered by PoE

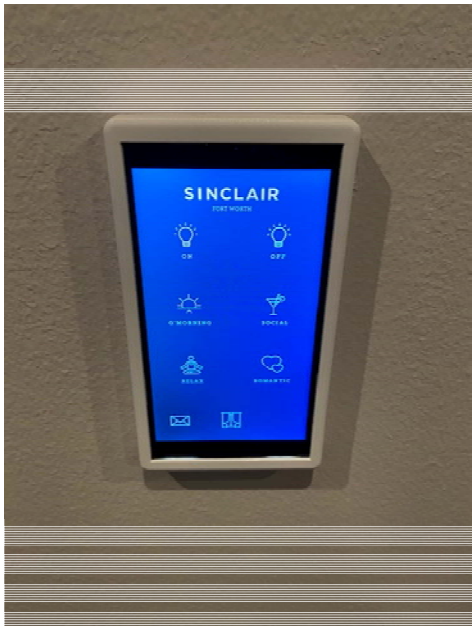
Electric mirrors

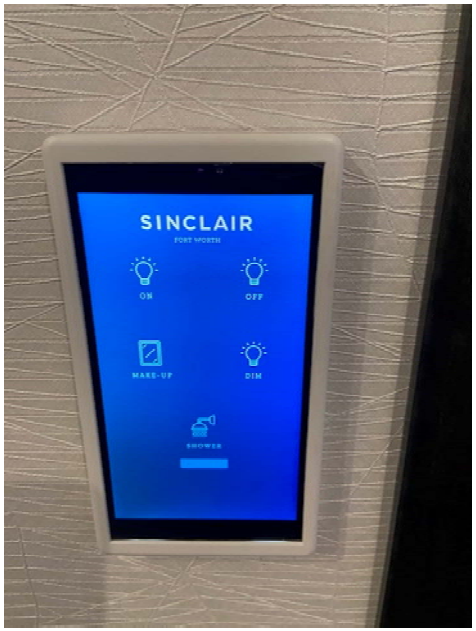


What Is Being Powered by PoE

Custom touch panels

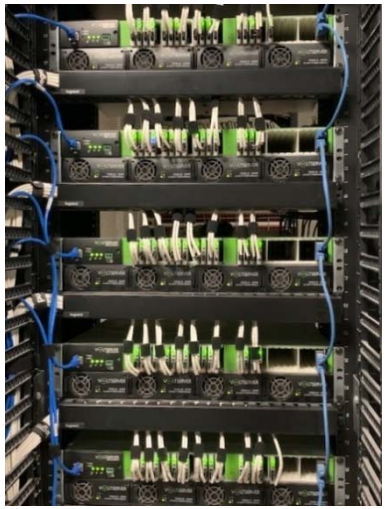






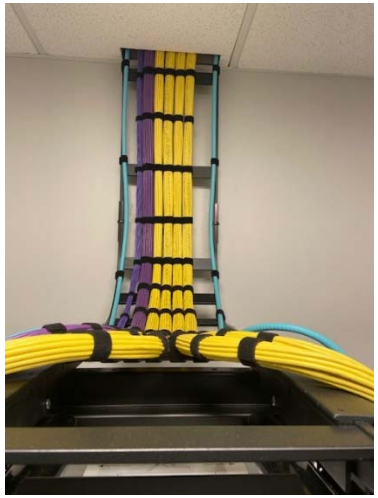
Digital Electricity Backbone

- Powering all CDB switches with 18/4 through the riser
- Emergency lighting powered from ESS room with digital electricity
- Saves space



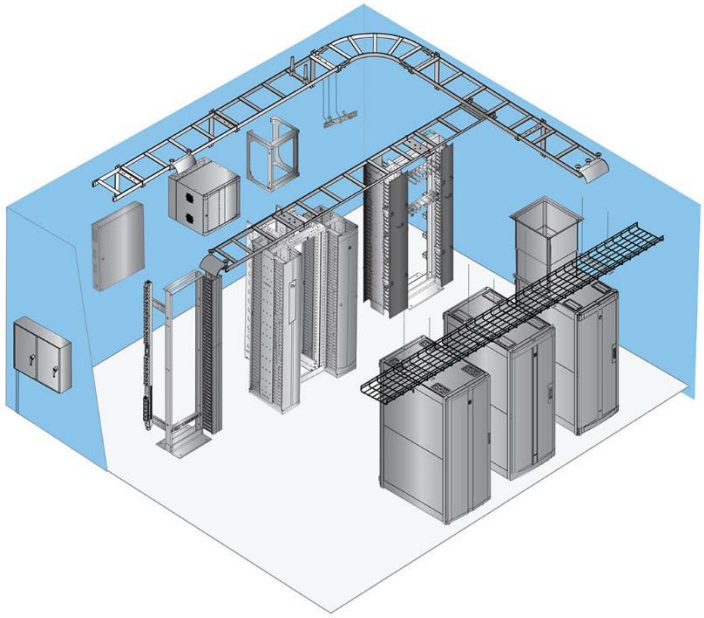
Overall Cabling Installation

350,000’	Superior Essex Cat5e PowerWise
10,000’	Superior Essex VoltServer Rated 18/12
20,000’	Superior Essex VoltServer Rated 18/8
185,000’	Superior Essex VoltServer Rated 18/4
225,000’	Superior Essex VoltServer Rated 18/2



Typical Room Layout

- Intelligent Building Infrastructure can be incorporated with all other Infrastructure designs
- Choose the right layout
- Make sure the design can adapt to change
- Don’t be afraid to customize



Lessons Learned

- Be Ready For Change
- Design For Change
- Coordinate with Partners
- Think Outside The Box
- Educate Yourself and Team
- Don’t Stop Learning

Future Possibilities For PoE

Where Is This Going?

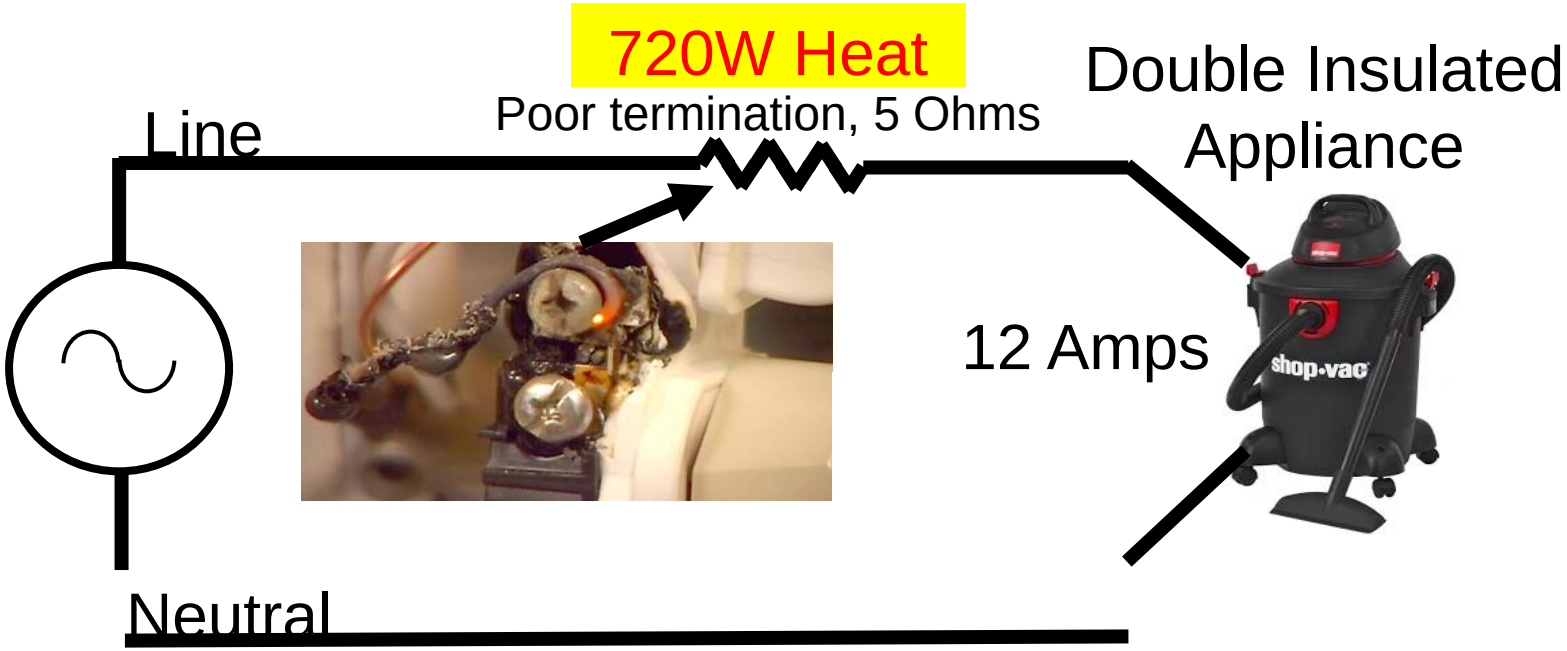
Digital Electricity Explained

PoE

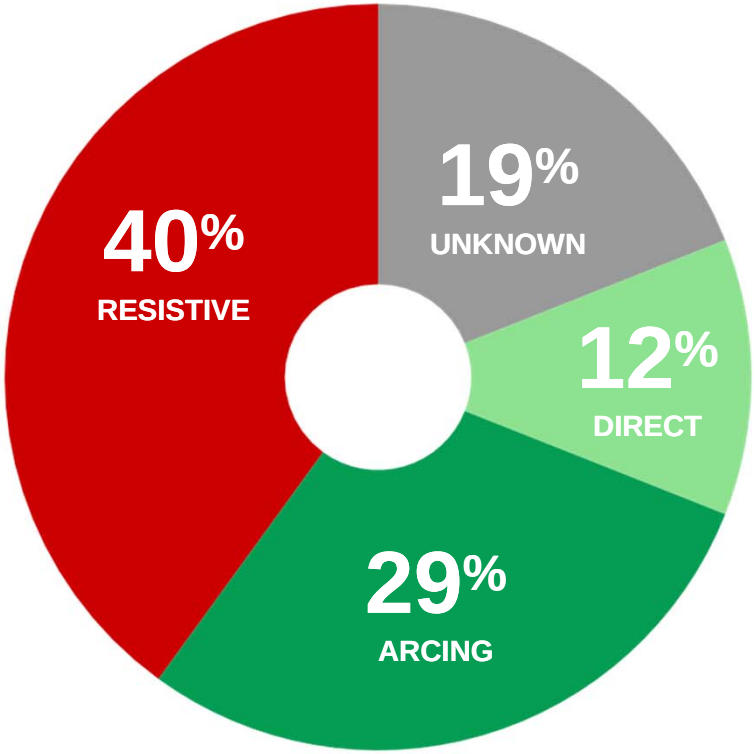
How Can Electricity be Made Inherently Safe?

What is Different about Digital Electricity (DE)?

DE is the Only Technology That Can Prevent a Resistive Fault



Causes of Electrical Fire in North America

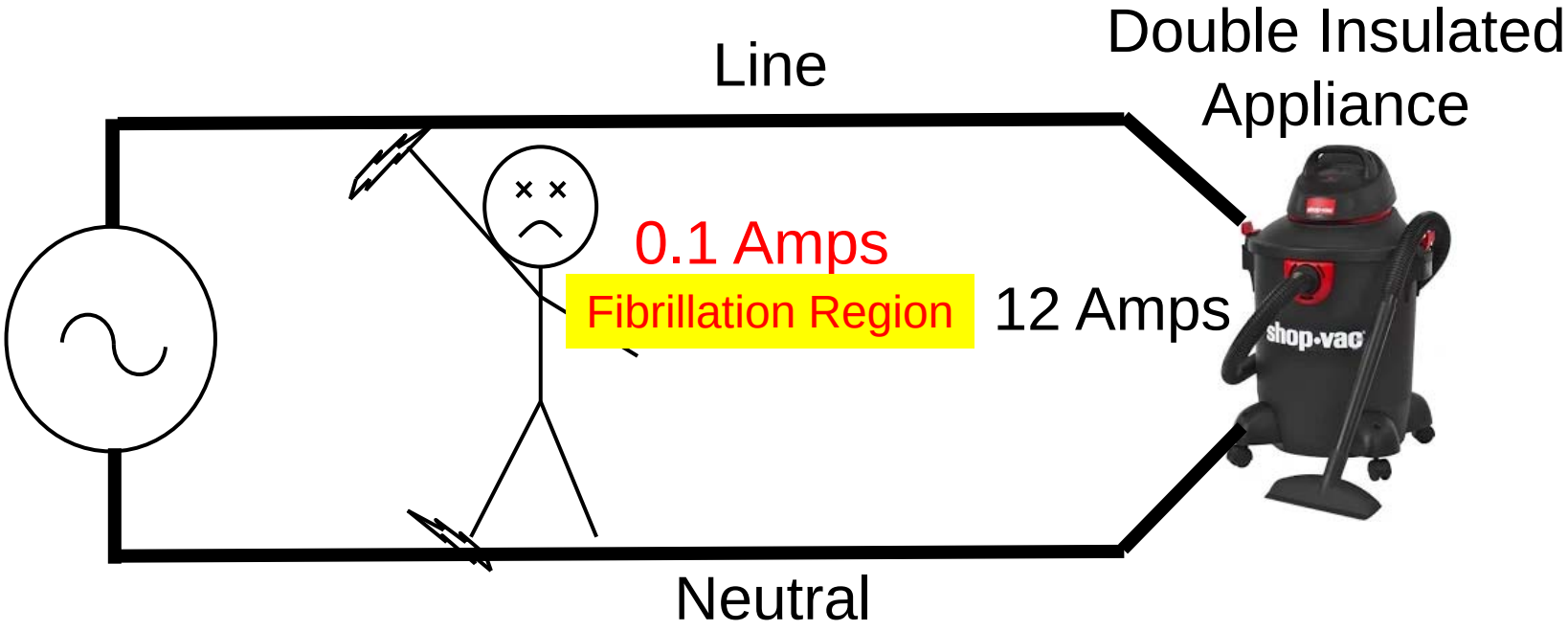


Electrical Ignition Causes

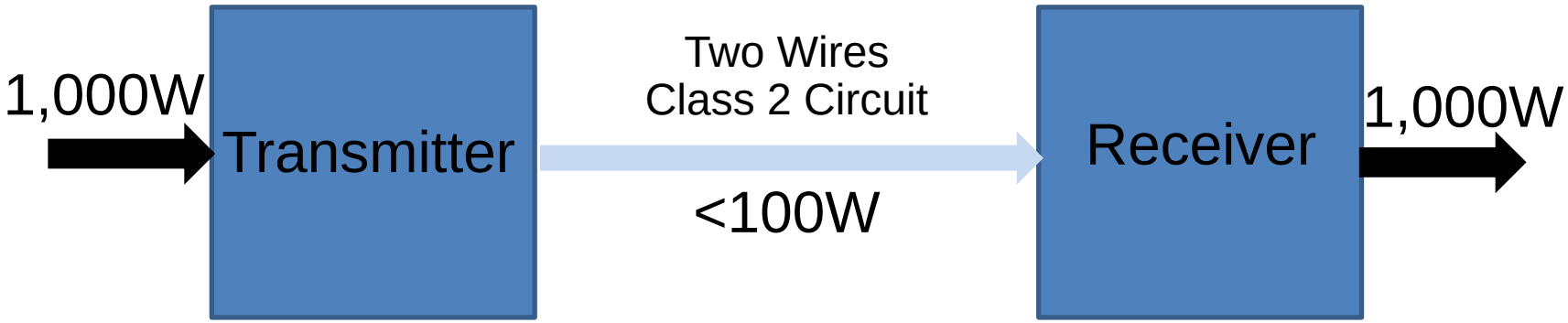
NA Major Fires (2002 - 2007)

Source: 2D2C, Inc.
http://iaeimagazine.org/magazine/2011/09/16/required-technology-to-prevent-electrical-fire-ignitions/

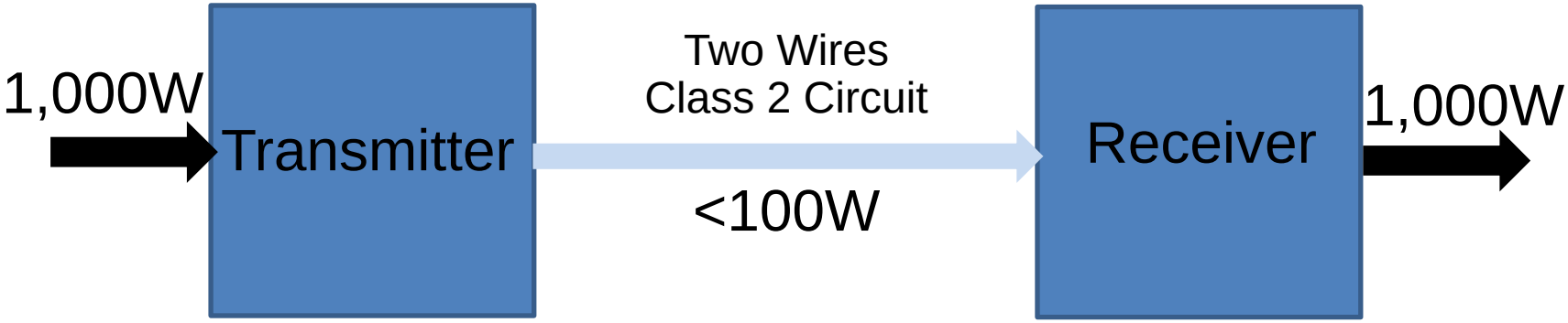
The Only Thing That Can Prevent a Line-to-Line Touch Fault



The Only Thing That Can Do This

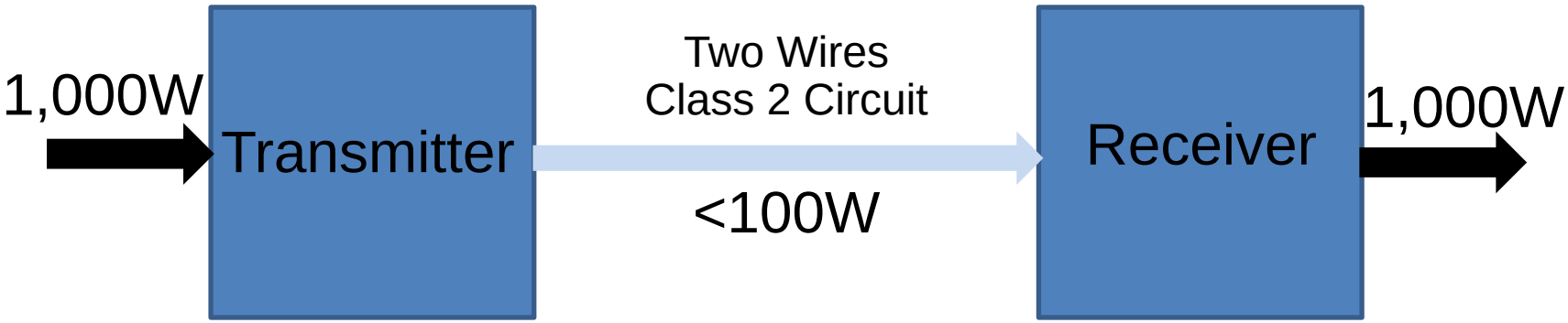


How?



Energy = The potential to do **Work**

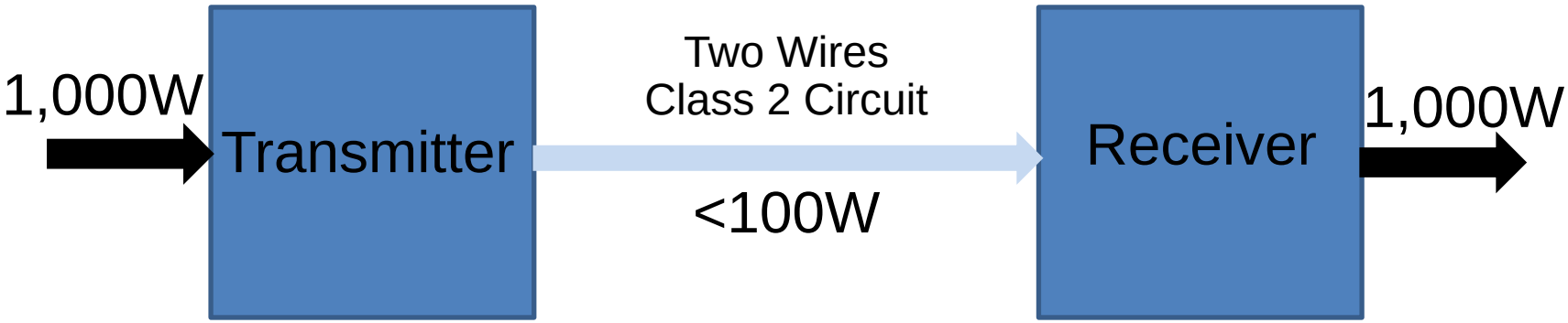
How?



Energy = The potential to do **work**

Power = The rate of converting **energy** to w**ork**

How?

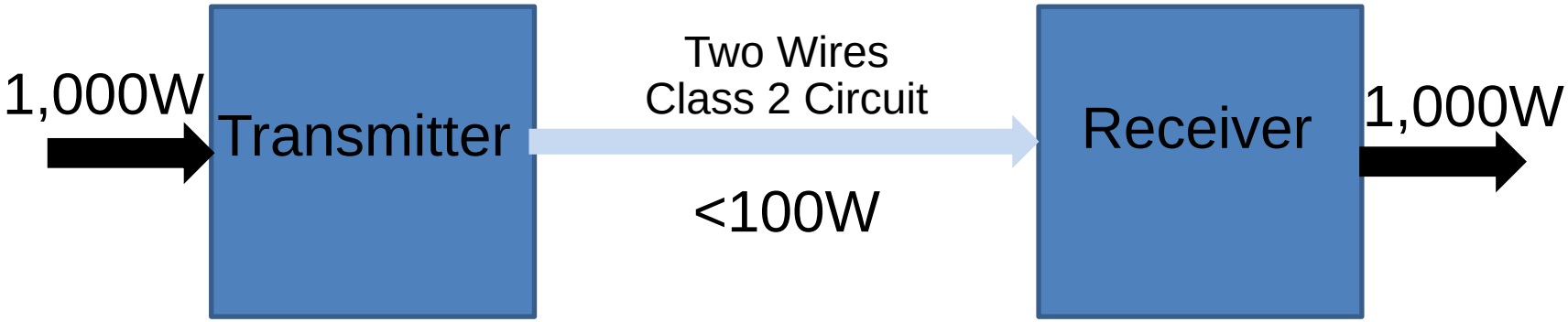


Energy = The potential to do w**ork**

Power = The rate of converting **energy** to **work**

Power is needed to hurt someone or start a fire

DE is the Only Thing That Can Separate Power and Energy



Power is needed to hurt someone or start a fire

DE transmission is almost exclusively **energy**

Electrical Hazards Mitigated by DE

HAZARD	YEAR	ANALOG AC/DC		DIGITAL ELECTRICITY
High Current	1960	Circuit Breaker		✓

Electrical Hazards Mitigated by DE

HAZARD	YEAR	ANALOG AC/DC		DIGITAL ELECTRICITY
High Current	1960	Circuit Breaker		✓
Ground Fault	1971	GFCI/RCD		✓

Electrical Hazards Mitigated by DE

HAZARD	YEAR	ANALOG AC/DC		DIGITAL ELECTRICITY
High Current	1960	Circuit Breaker		✓
Ground Fault	1971	GFCI/RCD		✓
Arc Fault	1999	Arc Fault Detector		✓

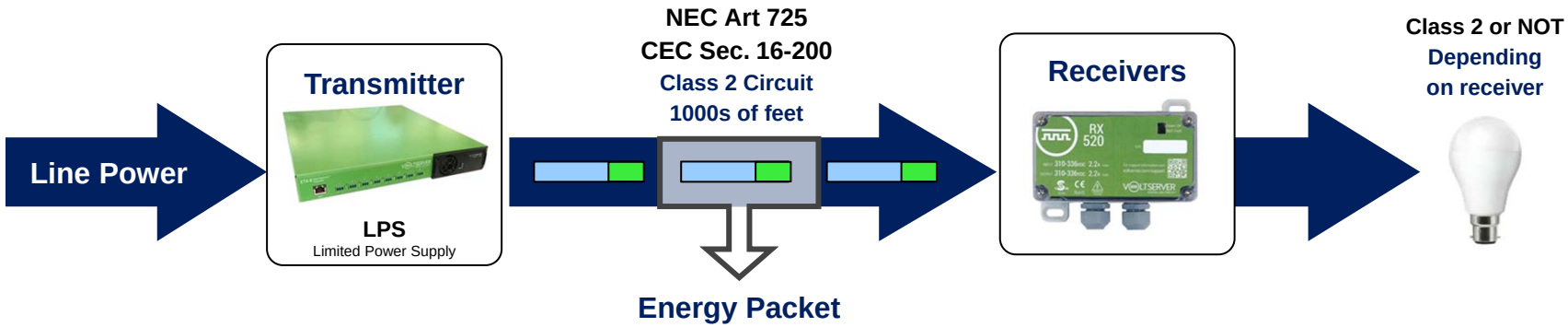
Electrical Hazards Mitigated by DE

HAZARD	YEAR	ANALOG AC/DC		DIGITAL ELECTRICITY
High Current	1960	Circuit Breaker		✓
Ground Fault	1971	GFCI/RCD		✓
Arc Fault	1999	Arc Fault Detector		✓
High Resistance	—	X		✓

Electrical Hazards Mitigated by DE

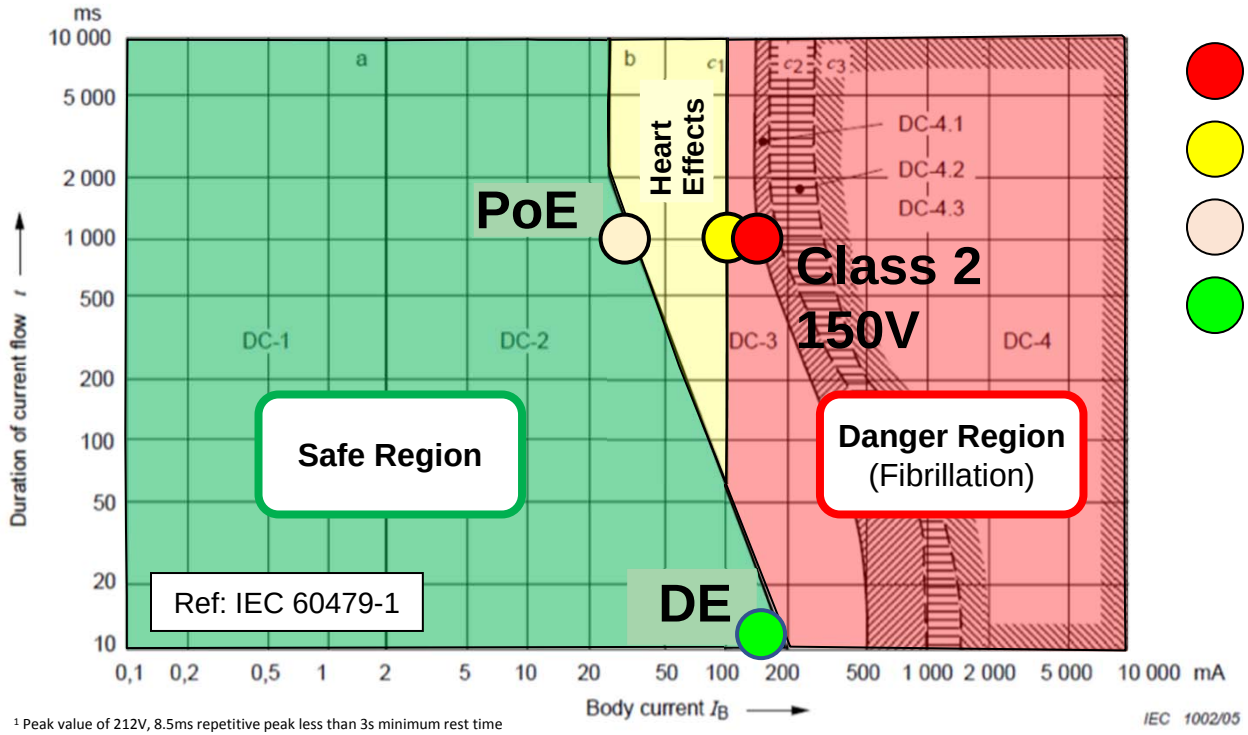
HAZARD	YEAR	ANALOG AC/DC		DIGITAL ELECTRICITY
High Current	1960	Circuit Breaker		✓
Ground Fault	1971	GFCI/RCD		✓
Arc Fault	1999	Arc Fault Detector		✓
High Resistance	—	X		✓
Touch	—	X		✓

Digital Electricity Explained



PROCESS **HOW it works**	**SEND** pulse (~500 per second) **1. STOP** **2. LOOK** for arc, thermal, touch, overcurrent, ground fault **3. VERIFY** Is it safe? send another pulse; else STOP **4. CONVERT** Receiver converts back to Analog Electricity (AE)

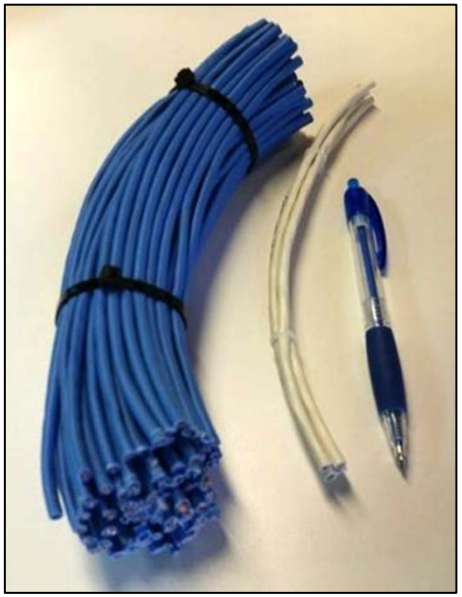
Electrical Hazard Category (IEC 62368-1)



- Class 2, 150V RMS[1]
- 110V RMS
- Class 2, 60Vdc PoE
- Digital Electricity [2]

[1] Peak value of 212V, 8.5ms repetitive peak less than 3s minimum rest time
[2] Actual exposure 3ms, IEC 62368-1 standard does not consider less than 10ms

Circuit Heating?



PoE **DE**

Parameter	PoE+	UPoE	DE
Distance(ft.)	328	328	**328**
Cables	96	96	**4**
Pairs	384	384	**8**
Gauge	24	24	**18**
Bundle Diameter (in.)	2.25	2.25	**0.5**
Power Delivered (W)	4,200	8,400	**8,400**
Heating (W/ft)	2.23	4.45	**1.11**

KLS2
KLS3

Typical Installation

DE

Multiconductor Cable
Riser (CMR), Plenum (CMP), Tray (PLTC)

- DE can run in risers or trays
- Can be in same duct or jacket with Ethernet/Fiber
- DE can not run with Power & Lighting circuits
- Install according to NEC Art 725

RX548 Receiver

Low-Voltage DC

PoE

Basement Electrical Rm

Slide 71

KLS2 I had to change the pic because it was a competitor
Kallail, Lauren S., 1/9/2020

KLS3 Kallail, Lauren S., 1/9/2020

Power/Distance

Power and Number of Pairs vs. Distance (feet)

	Power (W)	200	400	600	800	1000	1200	1400
18AWG	1pair	1,888	936	0	0	0	0	0
	2pairs	3,744	1,840	1,205	888	698	0	0
	3pairs	5,568	2,712	1,761	1,285	999	809	673
	4pairs	6,000	3,553	2,284	1,649	1,269	1,015	833

	Power (W)	200	400	600	800	1000	1200	1400
16AWG	1pair	2,996	1,485	0	0	0	0	0
	2pairs	5,942	2,920	1,913	1,410	1,108	0	0
	3pairs	6,000	4,305	2,794	2,039	1,586	1,284	1,068
	4pairs	6,000	5,639	3,625	2,618	2,013	1,611	1,323

700+ Installations in Marquee Venues






Transmitters

- Four 20A AC input feeds (110-208VAC)
- Up to 12kW bulk output (9kW N+1)
- 24 output channels (transmitter cards)
- 500W max per channel
- 2RU, 17.7” deep
- 39 lbs.
- UL/IEC 60950-1, 62368-1 (LPS)

- One 20A AC input feed (110-277VAC)
- Up to 3kW bulk output
- 8 output channels
- 500W max per channel
- 1RU, 14.5” Deep
- 11.5 lbs.
- UL/IEC 60950-1, 62368-1 (LPS)

Receivers

- Up to 4 DE inputs
- 2.4kW output at 40 °C
- HVDC Output (336VDC)
- 13” x 14.5” x 1.77”
- 3 lbs.
- IP 66
- UL/IEC 60950-1

- Up to 4 DE inputs
- 1.4kW output at 40 °C
- 54 VDC
- 10.04” x 9.45” x 3.99”
- 9.5 lbs.
- IP 66
- UL/IEC 60950-1

Receivers

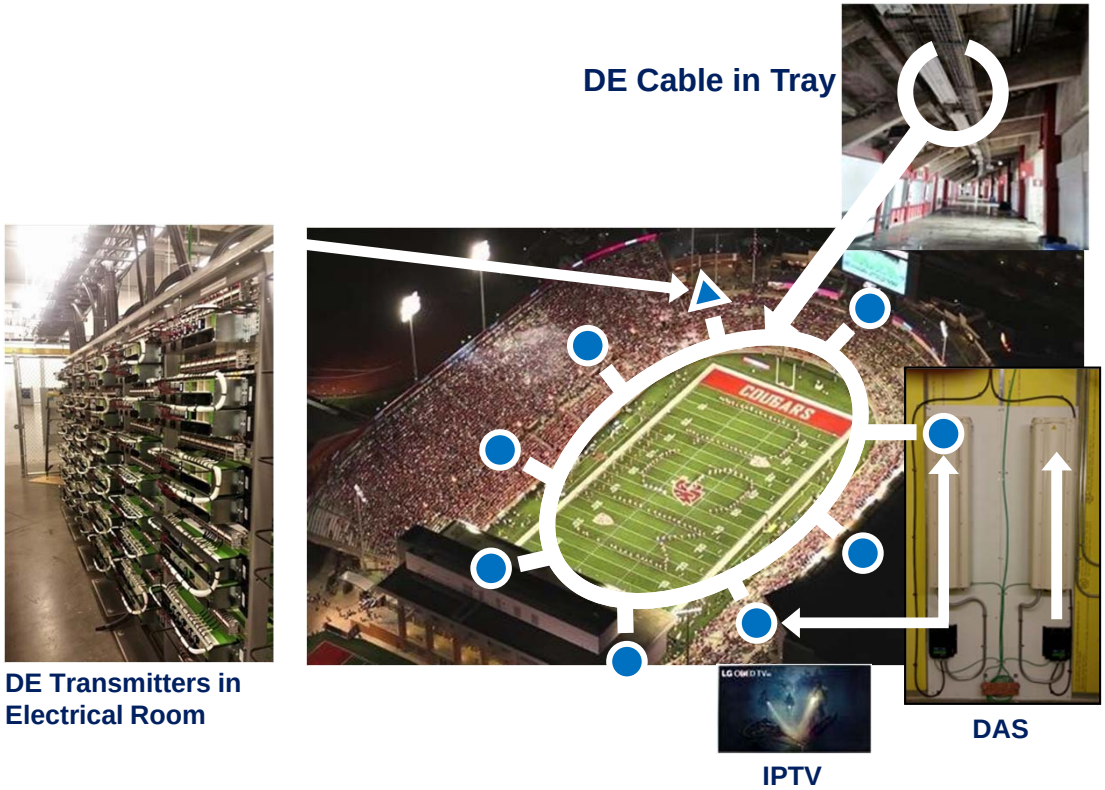
- One DE inputs
- 500W output @ 40°C
- HVDC Output (336VDC)
- 4.72” x 2.56” x 1.59”
- 0.49 lbs.
- IEC/UL 60950-1

- Two DE inputs
- 8 LPS output chans.
- Output 57VDC
- 80W per channel @ 40°C
- 13.5” x 10.33” 2.33”
- 10.5 lbs.
- IEC/UL 60950-1

More Case Studies

PoE

Connected Stadium/Arena



College Sports Stadium – Mobile densification project

- $136,000 VoltServer equipment
- Saved MSO Operator 21,000 feet of conduit + core boring
- Reduction from $34 to $10 per ft.

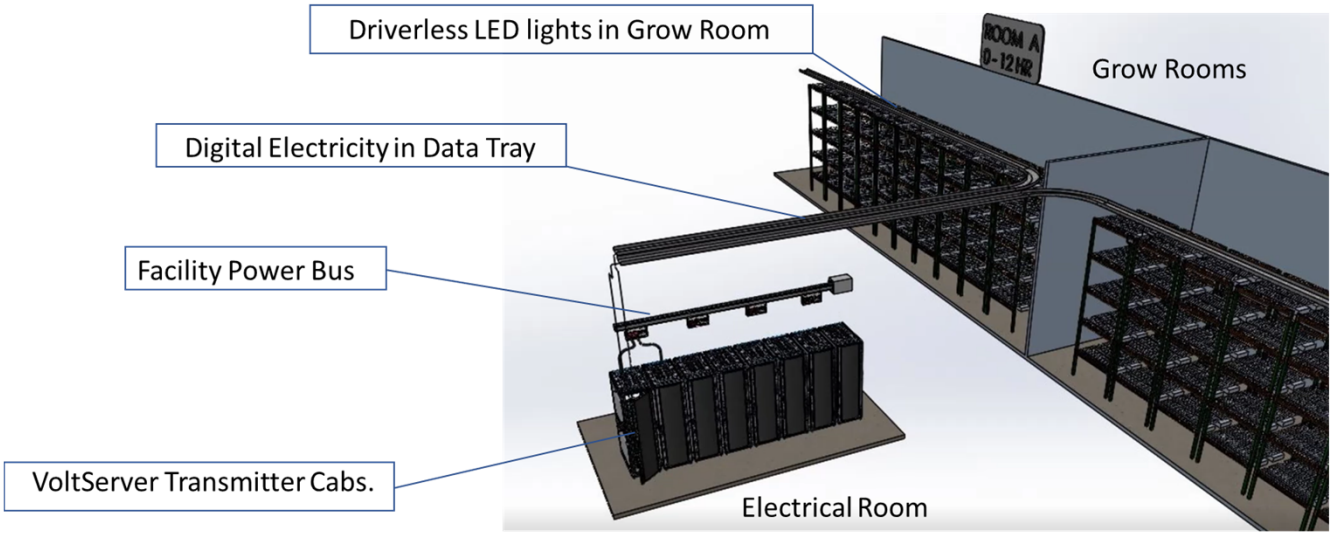
Mercedes-Benz® Stadium – 280 Miles of DE

5G

Indoor Agriculture

1MW Hardee County, Florida, Food/GreenSeal Cannabis 250kW, Stratford, Ontario

Indoor Agriculture Architecture



DAS Installation – High Rise

- 64 story, 950’ tall office tower
- Floors 1-18 were done “old school”
- Floors 19-64 were VoltServer application
- VoltServer equipment cost- **$110,000**
- $3M Project

When directly compared to the traditional wiring on the lower levels the estimate savings was:

$800,000

Questions?

Thank You!