



The Power of Ethernet - PoE & PoE+ Solutions

DIGISOL SYSTEMS LTD



This document provides a quick primer to the technology behind the hugely popular Power over Ethernet (PoE) setups. It also discusses business benefits, latest updates and technology stacks that make it click for enterprises worldwide.

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The Power of Ethernet - PoE & PoE+ Solutions

Introduction

Computer networking has grown in leaps and bounds since becoming a bedrock infrastructure supporting applications and appliances of all types and requirements.

Although the story of all computer networks always has been and will continue to be about data, a typical problem often encountered relates to power and its distribution thereof.

Common spoke-devices such as Wireless Access Points (WAP), IP cameras, VOIP phones and of late, switches, are often the last add-ons to an already constructed civil infra and structured cabling setup. These have power requirements that are not easy to meet at this point. Running an electric supply wire right next to the ethernet cable is always an option but this will come at a huge cost to aesthetics and change to existing civil infrastructure. Imagine running half a dozen power cables through the ceiling to power on your ceiling access points!

The Only Solution - Power over Ethernet (PoE)

Few would have expected the solution to be as simple as the requirement - using the same ethernet cable that carries data, to carry power as well.

Instead of laying a separate power cable to each spoke device such as surveillance cameras and access points, you will use the existing Cat 5/ 6 cable to transmit power over different pins without changing any part of your civil infrastructure.

The best part about PoE is that it not only supports PoE devices as per IEEE standards but will also allow non-PoE devices to exist on the same network helping you gain valuable ROI.

Business Benefits

- PoE installations are exponentially less cable-messy - lesser number of cable guide ways not only mean a decreased installation budget but also ROI from existing data network
- Go-live almost instantly!
- Enhanced Safety
- Flexibility of installation
- Simplicity of installation - Install & Forget
- In-built Power redundancy



Sample PoE Infrastructure

Fig 1. Basic PoE Setup & Terminologies



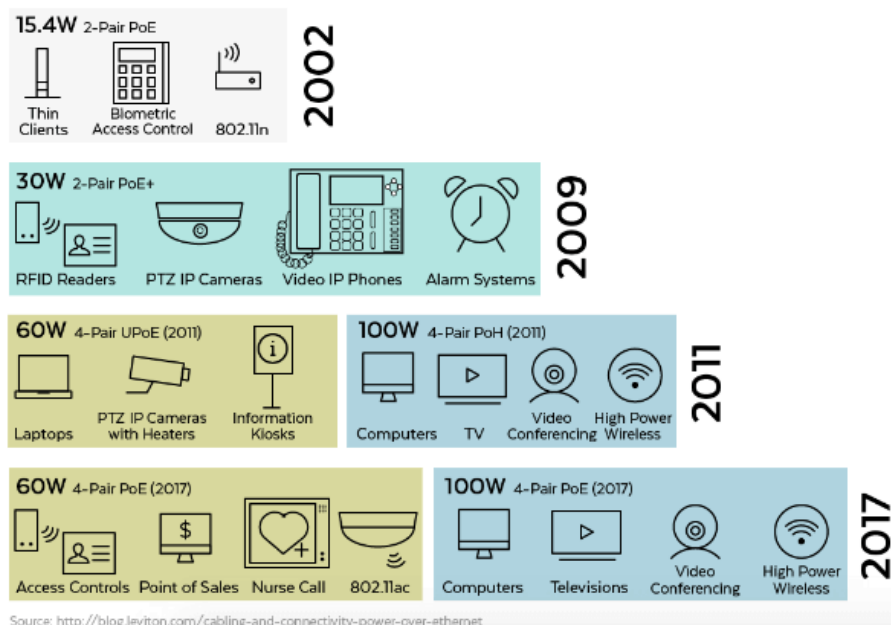
There are generally 2 types of devices on the network:

- Power Sourcing Equipment (PSE): nothing but devices that provide (source) power on the Ethernet cable. This device may be a network switch, commonly called an *endspan* or *endpoint*, or an intermediary device between a non-PoE-capable switch and a PoE device, an external PoE injector, called a midspan device.
- Powered device (PD): any device powered by PoE, consuming energy.

IEEE Official PoE Standards

IEEE Extension	Type	PoE+	Cable Type	Cable Length	Power Delivery
IEEE 802.3af	Type 1	15.4W	Cat 5e	100m	2 pairs
IEEE 802.3at	Type 2	30W	Cat 5e	100m	2 pairs
IEEE 802.3bt	Type 3	60W	Cat 5e	100m	2/4 pairs
	Type 4	90W	Cat 5e	100m	4 pairs



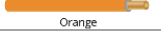









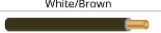
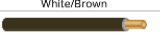
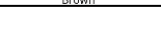
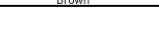
Fig 2. PoE Standards & Applications¹



Source: <http://blog.leviton.com/cabling-and-connectivity-power-over-ethernet>

IEEE Standard Pin Assignments

Fig 3. Pins Assignment²

Pin at switch	TIA/EIA-568 T568B Termination	TIA/EIA-568 T568A Termination	10/100 Mode B DC on Spares	10/100 Mode A Mixed DC and Data	1000 (1 gigabit) Mode B DC and Bi-Data	1000 (1 gigabit) Mode A DC and Bi-Data
1	 White/Orange	 White/Green	Rx+	Rx+	DC+	TxRx A+
2	 Orange	 Green	Rx-	Rx-	DC+	TxRx A-
3	 White/Green	 White/Orange	Tx+	Tx+	DC-	TxRx B+
4	 Blue	 Blue		DC+	Not Used	TxRx C+
5	 White/Blue	 White/Blue		DC+	Not Used	TxRx C-
6	 Green	 Orange	Tx-	Tx-	DC-	TxRx B-
7	 White/Brown	 White/Brown		DC-	Not Used	TxRx D+
8	 Brown	 Brown		DC-	Not Used	TxRx D-

Popular in-use PoE Standards

Parameter	PoE	PoE+
IEEE Standard	IEEE 802.3af	IEEE 802.3at
Rolled out in	2003	2009
Type	Type I	Type II
Max Power to PD	12.95W	25.5W
Max Power from PSE	15.4W	34.2W
Voltage Range (at PD)	37-57V DC	42.5-57V DC
Voltage Range (at PSE)	44-57V DC	50-57V DC
Max Current	350mA	600mA
Power Management	Class 0, 1, 2 & 3	Class 0, 1, 2, 3, 4
Maximum Cable Resistance	20 Ohms	12.5 Ohms
Cabling	Cat 3, 5, 5e, 6	Cat 5, 5e, 6
Common Use Cases	WAP, VOIP phones	PTZ Cameras, Alarm Systems, Video phones
Supported Modes	Mode A (endspan), Mode B (midspan)	

Standout difference - PoE vs PoE+

Besides the obvious enhanced power capabilities as illustrated above, PoE+ provides two other significant advantages that make it readily acceptable for deployment:

- Dynamic power negotiation based on load
- Backward compatibility with PoE setups saving huge ROI

What types of devices benefit from PoE?

- IP Cameras (e.g. PTZ types)
- Wireless Access Points
- Network Switches
- Industrial Controls
- Smart Clocks
- Security Access Controls
- PoS Kiosks
- Digital Signages



- Routers
- VoIP devices
- LED Lighting
- Thin clients

Interestingly, the growing IoT and Sensors market is trying to leverage the power of PoE for wide ranging applications.

PoE Power Classes

IEEE 802.3 PoE assigns classes; determined by the lowest common power level that can be supported by both the PSE and PD. This is done by the PSE communicating with the PD using the LLDP (Link Layer Discovery Protocol).

Class	PSE O/P (W)	PD I/P (W)	PoE Type	Standard
0	15.4	12.95	1	802.3af
1	4	3.84	1	
2	7	6.49	1	
3	15.4	12.95	1	802.3at
4	30	25.5	2	
5	45	40	3	802.3bt
6	60	51	3	
7	75	62	4	
8	90	73	4	

PoE Signalling

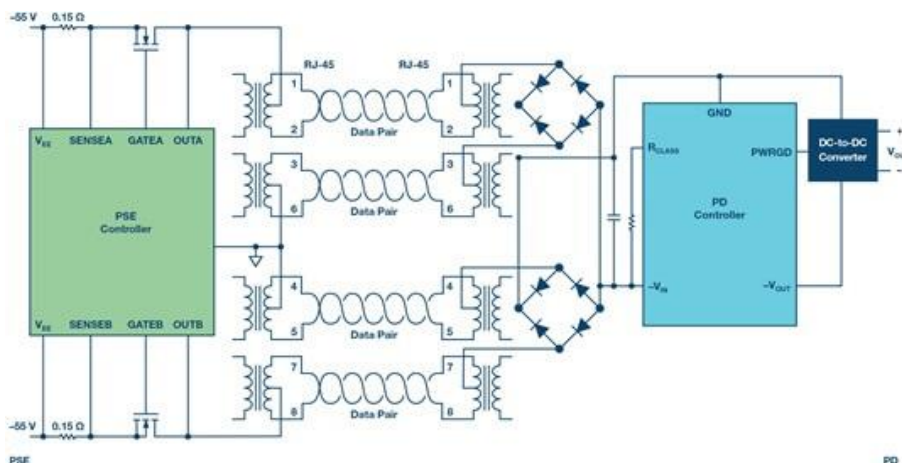
Fig 4. Signalling over 2 pairs (red)³

Fig 5. Signalling over 4 pairs³



PoE Block Diagram

Fig 6. PoE Block Diagram⁴





More about the latest IEEE 802.3bt Standard

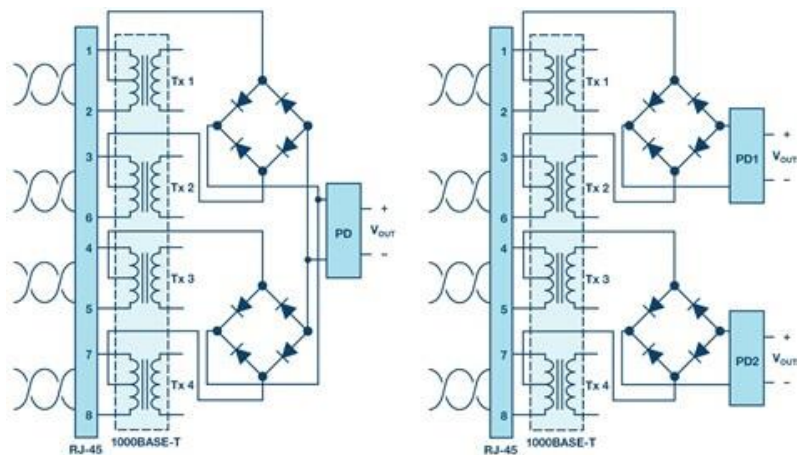
802.3bt introduces 2 different PD signature configurations:

- Single-signature PDs
- Dual-signature PDs

A “single signature PD” shares the same detection signature, classification signature, and maintain power signature between both pair sets.

A “dual signature PD” has independent detection signatures, classification signatures, and maintain power signatures on each pair set.

Fig 7. 802.3bt PoE Signature Configurations⁴



DIGISOL's PoE Stack

Digisol offers the finest-in-class PoE equipment (upto type 3) and high-quality ethernet cabling to boot.

- [DG-FS1006PF](#) - DIGISOL 6 Port Fast Ethernet Unmanaged Switch with 4 PoE Ports & 2 Uplink Ports + IEEE 802.3af / 802.3at support with 60W PoE Budget
- [DG-FS1526HP](#) - DIGISOL 24 Port Fast Ethernet PoE+ Smart Managed Switch with 2 Combo Ports IEEE 802.3af/ 802.3at support with 220W PoE Budget
- [DG-GS4952HPSE](#) - DIGISOL 48 Port Gigabit Ethernet PoE+ Fully Managed Layer 3 Switch + IEEE 802.3af/ 802.3at /802.3bt support with 740W PoE Budget
- [DG-IS4514HP](#) - DIGISOL 14 Port Gigabit Ethernet PoE+ Fully Managed Layer 2 Managed Din-rail Industrial Ethernet Switch + IEEE 802.3af/ 802.3at /802.3bt support with 240W PoE Budget

Future of PoE

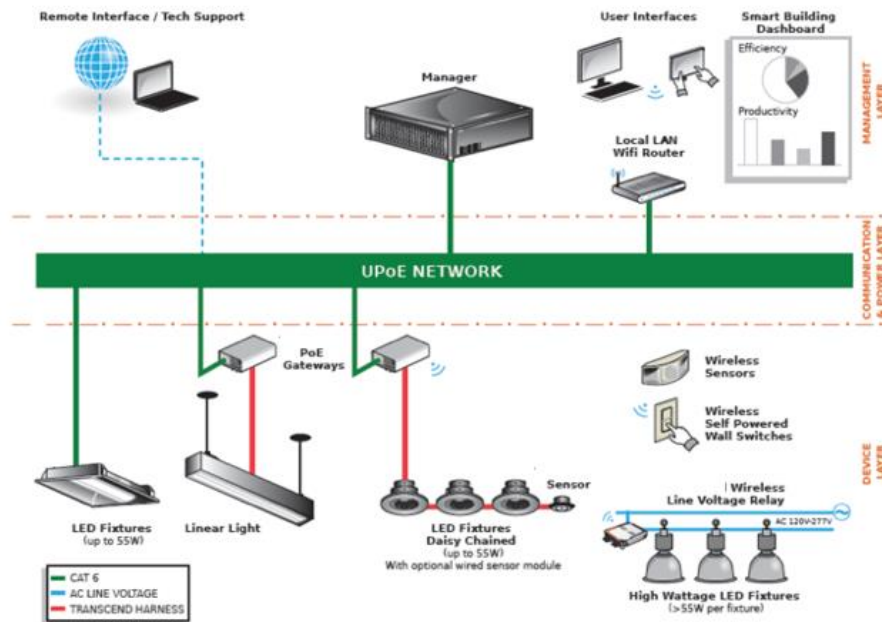
According to the new market research report "Power Over Ethernet Solutions Market by Type (PSE Controllers & ICs, PD Controllers & ICs), Device Type (Power Sourcing Equipment, Powered Devices), Application (Connectivity, LED Lighting Control), Vertical, and Geography - Global Forecast to 2022", the market is expected to grow from USD 451.1 Million in 2015 to reach USD 1,048.3 Million by 2022, at a CAGR of 12.56% between 2016 and 2022⁵.



Interesting PoE Case Study - US Dept of Energy

US Dept of Energy's multi-part effort to explore the energy reporting capability of commercially-marketed PoE connected lighting systems.

Fig 8. Schema Diagram⁷



Summary

Players from across industries - semiconductors, lighting, IoT and IT are all queuing up to work on better use cases for PoE as a technology per se.

The use cases show great potential in terms of both capability and ROI of existing asset base and future plans are likely to involve leveraging the enhanced power possibilities displayed by the latest IEEE 802.3bt standard. Corporates of all sizes, Government and even homes are vested in this great promise.

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