



White Paper

Discover the Full Potential of Hi-PoE

Introduction

Power over Ethernet (PoE) technology makes network deployment easier by allowing power and data to be simultaneously transmitted over a live data link via Ethernet cables, eliminating the need for power outlets or electrical wires. PoE system architecture has offered enormous advantages, including simple installation and expansion, reduced operating and capital expenses, and a dependable and secure power standard for all types of networks.

The demand for higher power delivery has grown since ratifying the 802.3af PoE standard (Type 1) in 2003. This evolution led to the development of the most recent PoE standard, the IEEE 802.3bt High Power PoE, or Hi-PoE. Hi-PoE, capable of providing Powered Devices (PD) with nominal power levels of up to 71.3W (100W from the Power Source Equipment or PSE), represents a significant leap in power delivery, reducing the standby power needed for the powered device. This white paper explores [Hi-PoE](#) in detail and its potential applications, providing insights to improve your network's reliability, cost efficiency, and scalability while keeping you updated on the latest advancements in the field.

Why Power Over Ethernet Hi-PoE? Why Now?

Hi-PoE was ratified in September 2018, coinciding with the Industrial Internet of Things (IIoT) era. Until then, the limited amount of power made available by previous IEEE standards had been the primary issue restricting PoE deployment with new IIoT applications.

While the original IEEE 802.3af PoE's 15.4W was sufficient for some devices, it fell short for others. For instance, PTZ cameras, robotics, LED lighting, RFID readers, or HD/4K monitors often require more power, particularly PoE-powered devices that support smart buildings and IoT installations. Power dissipation, which refers to the potential power loss in the system, further limits its practicality; an 802.3af PSE can supply 15.4W per port, yet the PD only receives 12.95W.

The IEEE approved the 802.3at PoE (Type 2) standard in 2009 to overcome these drawbacks. Also known as PoE+, 802.3at increased wattage to 30W. As with 802.3af, however, a portion of the 30W is lost during transmission, leaving just 25.5W of maximum power at the PD. Network managers were left wanting more.

Enter IEEE 802.3bt. This standard has Type 3 60W (PoE++ or UPoE) and Type 4 100W (Hi-PoE). The chart below compares the four types of PoE.

Name	PoE	PoE+	PoE++ UPoE	High Power PoE
PoE Standard	IEEE 802.3af	IEEE 802.3at	IEEE 802.3bt	IEEE 802.3bt
Max. Power Per Port	15.4W	30W	60W	90W
Power to PD	12.95W	25.5W	51W	71.3W
Twisted Pair Used	2-Pair	2-Pair	4-Pair	4-Pair
Supported Cables	Cat5e	Cat5e	Cat6a	Cat6a

Unlike 802.3af or 802.3at, which operate on two twisted pairs for power transmission, 802.3bt utilizes four twisted pairs. Applying eight wires per cable (four pairs) minimizes power loss. IEEE 802.3bt pushes power limits to 100W, the maximum amount of power that can be delivered on each port as defined by Safety Extra Low Voltage (SELV) requirements for safe and reliable operation.

Support For New Classes

All four types of PoE in IEEE 802.3 are assigned a "class" ranging from 0 to 8. This class system helps to eliminate guesswork and better manage a PSE's power budget. Classes form using the lowest standard power level that the PSE and the PD can support. It is crucial to ensure that devices support PoE for compatibility and efficient power management.

While Type 1 (PoE) and Type 2 (PoE+) support Class 0-4, Type 3 (PoE++) supports Class 5-6, and Type 4 (Hi-PoE) supports Class 7-8. IEEE 802.3bt is backward compatible with 802.3at/af, enabling support for multiple PoE classes.

The chart below shows a PoE power level comparison per class.

Class	IEEE PoE Standard	PSE - Max Power Delivered (W)	PSE Voltage Range	PD - Power Available (W)	PD - Power Available (W)
0	IEEE 802.3af, PoE (2 pair)	15.4	44-57 V	12.95	37-57 V
1		4	44-57 V	3.84	37-57 V
2		7	44-57 V	6.49	37-57 V
3		15.4	44-57 V	12.95	37-57 V
4	IEEE 802.3at, PoE+ (2 pair)	30	50-57 V	25.5	42-57 V
5	IEEE 802.3bt, Type 3 (4pair)	45	50-57 V	40	42-57 V
6		60	50-57 V	51	42-57 V
7	IEEE 802.3bt, Type 4 (4 pair)	75	52-57 V	62	51-57 V
8		90	52-57 V	73	51-57 V

Single And Dual Signatures In PoE Standard

In addition to an expanded range of classes, the IEEE 802.3bt standard also introduced new “single” and “dual” signature topologies for PDs.

A single-signature PD has a single detection circuit and a single classification circuit. It shares the same classification, Maintains Power Signature (MPS), and detects signatures during handshakes. In contrast, a dual-signature PIR detector has two separate detection and classification circuits. Let me explain this with an example. A dual-signature PIR detector architecture can connect one pair to the camera in a video surveillance application.

In contrast, the other PIR detector can connect to a heater or the PTZ motor. There are two types of pair sets, and dual-signature PIR detectors need two parallel interfaces, making this approach more costly.

The IEEE 802.3af/at PoE standards cannot distinguish between single-signature PDs and dual-signature ones. However, using a new Connection Check feature, the 802.3bt standard enables the differentiation between these two connected device types. Another new feature is Autoclass, an optional extension of the physical layer classification. When Autoclass is on, the PSE can determine the maximum power drawn by connected PD devices, enabling more efficient power budgeting. However, Autoclass only works with single-signature PDs. Power sourcing equipment (PSE) delivers power and data through Ethernet cables to connected powered devices (PDs), and it can be categorized into ‘endspan’ devices, typically network switches, and ‘midspan’ devices, which serve as intermediaries or external injectors to supply power to non-PoE-capable switches.

Backward Compatibility

IEEE 802.3bt is backward compatible with 802.3at and 802.3af PDs, allowing a higher-power 802.3bt PSE to connect trouble-free to a lower-power 802.3at or 802.3af PD. When the roles reverse, and a lower power 802.3at or 802.3af PSE links to a higher power 802.3bt PD, the PD only has to be able to function in the corresponding lower power state. This process, known as 'power demotion,' Ensures that the PD automatically reduces its power consumption to match the lower power supply available. However, if the PD ignores the power demotion and operates at its highest power state, the DC power PSE will continually turn on, reach its current limit, and turn off repeatedly. For this reason, both 802.3at and 802.3bt require power demotion.

Powered Devices Benefiting From Hi-PoE

Hi-PoE has extended the benefits of lower wattage PoE standards to a new range of power-hungry devices, opening up exciting possibilities. Connected PoE devices are crucial in managing power and ensuring compliance with IEEE PoE standards, preventing damage to non-PD devices. Here's a glimpse of the types of devices that can benefit from Hi-PoE and the exciting opportunities it brings:

- **Pan-Tilt-Zoom (PTZ) IP Network Cameras:** A motorized PTZ camera, with its higher power consumption, often exceeds the limitations of 802.3af/at and PoE switches. IEEE 802.3bt PoE, with its high-power [PoE switch](#), provides a practical and reliable solution, ensuring power requirements are met.
- **LED Lighting:** Hi-PoE Ethernet switches can supply LED lights with up to 90W of power, reducing facility energy consumption by up to 80 percent compared to traditional incandescent, fluorescent, or HID lighting sources. Applying the 802.3bt standard lowers the minimum standby power required when the transmit power to an LED luminaire is off. The newest standard reduces minimum standby power to 20mW, approximately 10 times less than older IEEE standards.
- **802.11ac/ax Wireless Access Points (WAP):** Offices, warehouses, factories, and industrial sites that rely on wireless networking frequently deploy high-performance WAPs to allow authorized users to access the network. Newer 802.11 ac/ax WAPs may require more than 60W to function correctly. These WAPs can be linked to Hi-PoE Ethernet switches to supply needed power. In addition, PoE adds flexibility, whereas WAP can be mounted to achieve the best signal.
- **IIoT Sensors:** Controlling and collecting data on industrial processes requires sensors that can connect to cloudbased services for remote access. Power consumption depends heavily on sensor features and functions such as onboard data logging, wireless transmitting, and the number of internal electronics drawing power (i.e., transistors, capacitors, ICs, resistors). Next-generation sensors are increasingly complex and demand wattage beyond the limitations of 802.3af/at.

Choosing An 802.3bt Industrial PoE Switch

When upgrading a network infrastructure to take advantage of the IEEE 802.3bt PoE standard, it's critical to consider all the PDs that will be connected and calculate their power requirements to establish a power budget. [Ethernet switch](#) and PoE device capabilities are essential when upgrading a network infrastructure for 802.3bt. Ensuring compatibility and compliance with the power over Ethernet (PoE) 802.3bt standard is crucial. The [industrial switch](#) and connected PD end equipment must be interoperable and compliant with the 802.3bt standard. Many industrial Ethernet switch manufacturers promote compatibility with the 802.3bt standard but only deliver the Type 3 power level of 60W. [Leonton](#) has implemented the 802.3bt standard to a total of 90 watts in its multiple-port Gigabit industrial managed and unmanaged Ethernet switches, Gigabit Type 3 and Type 4 industrial Gigabit injectors, and Ethernet-to-Fiber industrial PoE [Media Converters](#).

[Leonton's 802.3bt](#) equipment line continues to evolve to keep pace with network power requirements, ensuring reliable performance for applications in industries such as transportation, surveillance, and manufacturing, where robust and high-power network solutions are essential. As the demand for more powerful and efficient PoE solutions grows, Leonton remains committed to delivering products that meet and exceed the current industry standards. Our 802.3bt solutions include media converters, injectors, industrial managed switches, and industrial unmanaged switches. One of our most popular managed PoE switches is the [CBG5-0602-SFP](#); it is a 6-Port industrial compact managed gigabit Ethernet 802.3bt PoE switch. Leonton makes sure to provide customers with future-proof network infrastructure and technology that supports the latest technological advancements, supporting applications with multiple connected PoE devices.



CBG5-0602-SFP(-T)

6-Port Industrial Compact Managed Gigabit Ethernet 802.3bt PoE++ Switch



GINJ-0201-BT-12-T

Industrial Gigabit PoE++ Injector



BG5-0702-SFP(-T)

7-Port Industrial Gigabit IEEE 802.3bt PoE++ Managed Ethernet Switch



GINJ-0201-EBT-12-T

Industrial Gigabit Enhanced 802.3bt 100W PoE++ Injector



BG5-0702-SFP-24(-T)

7-Port Industrial Gigabit IEEE 802.3bt PoE++ Managed Ethernet Switch Low-voltage Version



MBG2-0201-SFP

Industrial IEEE 802.3bt PoE++ Media Converter