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White Paper

The Role of Power over Ethernet in Copper Network Growth

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Introduction

Over the past 14 years, Power over Ethernet (PoE) has steadily increased its footprint in enterprise applications. Driven by market demand for a greater range of devices and smart building initiatives, as well as new IEEE standards supporting higher power levels, PoE is expected to continue its upward growth trajectory in the coming decade. PoE-enabled port and device sales are projected to grow from $45 million in 2015 to $1 billion by 2021,[1] and the overall PoE market is expected to reach $3.7 billion by 2025.[2]

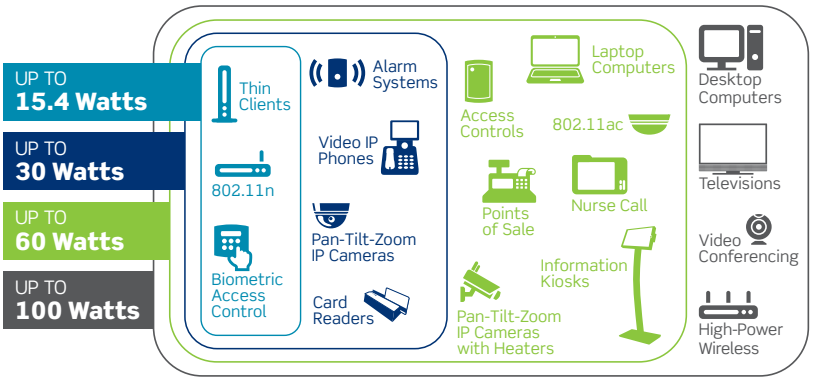
Historically, PoE adoption rates have increased in parallel with the adoption of new PoE standards. When the original PoE standard, designated Type 1 PoE, emerged in 2003 with the publication of IEEE 802.3af, only a handful of applications were projected for the technology, including thin clients and remote access control devices. Type 1 PoE enabled 15.4 watts of DC power to be sent from power sourcing equipment over two of the four twisted pairs of Cat 3 cable or higher. This early form of PoE supported 10BASE-T and 100BASE-T, delivering 12.95 watts through 350mA of current to a powered device for Ethernet speeds up to 100Mb/s.

In 2009, IEEE introduced 802.3at, also known as Type 2 PoE or the PoE+ standard. The 802.3at standard doubled the power that could be sent via PoE — up to 30 watts — and recommended Cat 5e cabling as the minimum cable grade, while supporting 1000BASE-T over Cat 5e or 6. With the ratification of 802.3at, 25.5 watts and 600mA of current could be delivered to devices over two of the four pairs, with backwards compatibility to 15.4 watt PoE. With the new standard came new applications; primarily VoIP phones and IP security cameras supported by network cable connectivity and power.

While the initial and current PoE standards prescribed power transfer over two cabling pairs, a new PoE standard is currently in development that will define four-pair power, once again doubling the amount of available power. In addition, by transmitting power via all four pairs in the cable rather than only two, four-pair PoE increases the efficiency of power delivery by as much as 50%.

	Number of Pairs Needed	Max. Power Output for PSE	Usable Power Budget for the End Device (PD)	Standard
PoE	2	Class 1: 15.4 Watts	12.95 Watts	IEEE 802.3af, Type 1
PoE+	2	Class 4: 30 Watts	25.50 Watts	IEEE 802.3at, Type 2
PoE++	4	Class 6: 60 Watts	49 Watts	IEEE 802.3bt, Type 3
PoE++	4	Class 8: 90 Watts	96 Watts	IEEE 802.3bt, Type 4

In 2013, IEEE launched a task force to create 802.3bt, an updated PoE standard that will include support for 10GBASE-T and define two new tiers of PoE: Type 3 for up to 60 watts, and Type 4 for up to 100 watts. As with Type 1 and Type 2 PoE, power and data will not interfere with each other, although they are both carried over the same conductors simultaneously.



Both PoE tiers under the 802.3bt standard will support a range of enterprise devices, such as laptops and desktop computers, exterior-mounted IP cameras, information kiosks, industrial automation equipment, and next-generation wireless access points (WAPs). Publication of 802.3bt is anticipated for Q4 of 2018.

[1] "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," MarketsandMarkets™ Inc., October 2016

[2] "Power Over Ethernet Market Size to Reach USD 3.77 Billion by 2025," Grandview Research, November 2016

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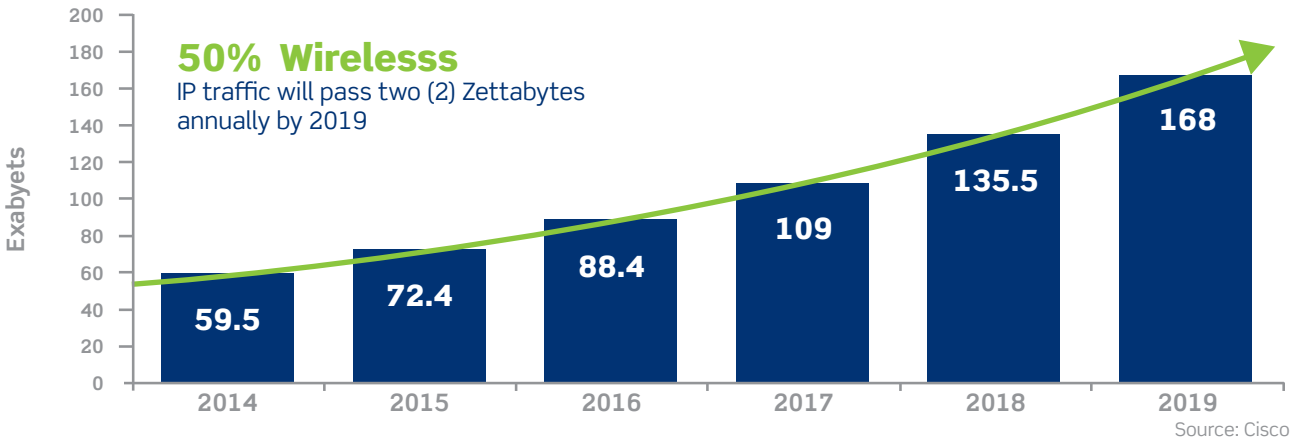
Trends in PoE Applications and Future Network Growth Projections

PoE is increasingly being deployed across market channels due to its defining attributes of convenience, ease of installation, and efficient operation. A number of PoE-supported critical applications are currently experiencing rapid growth, and are anticipated to continue to do so when high-power PoE becomes an adopted standard through IEEE 802.3bt.

Enterprise Wireless

Wireless data is growing exponentially and is expected to escalate consistently in coming years. By 2019, IP traffic is projected to surpass two zettabytes annually.[3]

Impact



Source: Cisco

The increase in enterprise wireless is being driven by a number of factors, including:

- BYOD (Bring Your Own Device) policies in business environments
- Adoption of video conferencing and Voice over Wi-Fi, which grew to 15.7% of all mobile IP voice traffic in 2015 and is projected to grow to 52.9% in 2020.4
- Proliferation of mobile devices, which are expected to experience a 57% compound annual growth rate.5
- Introduction of "smart machine" manufacturing equipment
- Installation of digital learning applications and security devices in primary and secondary education settings
- Increased use of networked medical equipment and wireless medical recording devices in health care facilities

Intelligent Buildings

Intelligent building applications rely heavily on PoE technology. A 79% annual growth in sensor deployment in commercial real estate is expected over a five-year period from 2015 to 2020.[6] Many intelligent building applications, such as security access systems, lighting, and building management systems, have high-power, low-data requirements. These requirements are driving the development of new cable products, including larger gage conductor (AWG) Cat 5e cables, which can support up to 1 Gb/s transmission of data with concomitant high-power transmission capabilities.

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[3] "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015-2020," Cisco Systems, Feb. 3, 2016

[4] "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015-2020," February 2016

[5] "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015-2020," February 2016

[6] "Smart Buildings: How IoT Technology Aims to Add Value for Real Estate Companies," Deloitte University Press, 2016

PoE-Powered LED Lighting

Significant growth of PoE-powered LED lighting is expected in the near future: as much as 43% annually.[7] Over a four-year period, LED market penetration — which was at 6% in 2012 — grew to 31% in 2016. It is expected to reach 60% in 2020, representing a total installation of nearly 260 million LED devices, a large percentage of which will be PoE-enabled.[8]

	2012	2016	2020
Luminaries	311M	365M	431M
LED Penetration	6%	31%	60%
Total LED	18M	113M	258M

Source: ieee802.org

Five Market Drivers Fueling PoE Adoption

Evolving Ethernet standards have continually expanded the potential of PoE. Over the course of more than a decade, PoE has advanced to encompass a tremendous range of devices and applications. As PoE standards are adapted to support more devices, the technology will become ubiquitous throughout enterprise networks.

Numerous markets have identified a need for higher power delivered via PoE, including the health care, retail, finance, commercial, office, security, and industrial sectors. There are five major market drivers fueling the continually evolving PoE standards and increasing power delivery capabilities.

1. PoE eliminates the need for separate network and power wiring installations by running power and data transmission over the same cable, providing significant cost savings for cabling material, labor, and administration.

2. Through the consolidation of disparate devices into a single unified system, PoE improves network control, allowing for faster deployment of the endpoint, especially to devices at remote building locations, such warehouse transaction work areas, WAPs, security cameras, and sales kiosks.

3. Instead of maintaining separate power supplies for every device, PoE allows for the centralization of power into one location, which can offer greater operational efficiency.

4. PoE is playing a key role in technology expansion, allowing new intelligent devices, including PoE lighting, to be connected seamlessly to a single network using a standardized interface for both power and data.

5. PoE systems that have been designed to meet current and emerging standards allow for the implementation of future-proofed networks, including the Internet of Things (IoT) and new smart building controls that adapt to individual users and deliver advanced energy usage metrics. As a highly scalable technology, PoE can be readily expanded to meet the needs of a business as it grows, with lower energy costs and a reduction of redundant network infrastructure for long-term sustainability.

[7] "Lighting as a Service: Third-Party Management of Lighting Systems in Commercial Buildings: Global Market Analysis and Forecasts," Navigant Research, 2016

[8] "An overview on high speed optical wireless/light communications," ieee802.org, July 2017

1. Cost Savings

As a component of enterprise infrastructure, PoE delivers significant cost reduction compared with traditional cabling installations comprising data cabling for network traffic and line voltage cabling for powering devices. According to a study by Cisco, installations with electrical wiring for AC current are 20% more expensive than PoE-based systems.[9]

A reduction in upfront capital is not limited to cabling, but includes wiring installation supplies and components, as well as labor and maintenance. Instead of necessitating the services of a data network cable installer and a licensed electrician, a low-voltage PoE cabling system can be installed by a single contractor. This reduces overall labor costs while cutting total installation time in half, resulting in higher project payback rates.

With only a single unified power and data cabling system needing to be maintained, the total system operating cost drops. Remote management of devices networked via PoE can be accomplished using Simple Network Management Protocol (SNMP), enabling remote monitoring of the network and resolution of issues from a centralized staffing facility, rather than multiple onsite staffing units or costly travel to isolated locations.

PoE also delivers long-term cost reduction. Recent estimates indicate that up to 50% of energy typically wasted by an organization can be eliminated by proper design of PoE and intelligent building systems.[10] This is due in large part to PoE's capacity for energy management, which enables a demonstrable reduction in power consumption and waste. When integrated with other building solutions, the average PoE-enabled building can save up to 40% in energy costs.[11]

2. Improved Network Control

Networked PoE devices constitute a single administrative system that can be overseen from a centralized location. The centralized control and simplified management capabilities of a PoE system provide a measurable reduction in human error and business risk compared with systems that rely on non-networked hardware powered by line voltage and locally supported by onsite staff.

Network system downtime poses a significant financial risk for enterprise, costing the average midsize business $1 million per year, and larger enterprises up to $60 million annually.[12] Devices networked to collect and share data with other devices or systems via SNMP are critical sources of information, relaying details about the status of all components of a network and their real-time interaction and performance. Additionally, PoE reduces network downtime during unplanned maintenance or disaster scenarios by enabling the continuous extraction and storage of data from all devices on a network in a remote back-up facility.

PoE also actively increases network uptime and reduces outages. Power sourcing equipment can be connected to an uninterruptable power supply (UPS) to prevent lighting, security, monitoring, and mission critical systems from losing power during a localized power outage. The risk associated with shock hazards is greatly mitigated in a PoE system, compared with networks that rely on power from line voltage. PoE's use of lower amperage and negotiation protocols between the power sourcing equipment and powered devices establishes a protective delay that reduces the risk of shocks typically associated with power set-up.

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[9] "Cisco Digital Building Solution," white paper, Cisco Systems

[10] "IoE benefits transform the commercial high rise," Cisco Systems, 2015

[11] "Cisco Digital Building Solution," infographic, Cisco Systems, 2017

[12] "The High Price of IT Downtime," Network Computing, January 2016

3. Operational Efficiency

As an integrated component of an enterprise IT network, PoE devices in an environmental control system share crucial information with devices and control systems throughout the network, including facility and operational management applications and tools. PoE-connected devices such as LED lights and sensors are capable of collecting highly localized data on a number of environmental factors, including temperature, humidity level, ambient light, and occupancy levels. PoE also enables proximity sensors to support advanced applications that source data from building occupants' mobile devices or workspaces.

This information can be used to make strategic business decisions resulting in more efficient space management and operational efficiency of the building. The data is also available as a valuable tool to improve worker productivity, which a recent study found can be enhanced by 16% with personalized lighting and environmental controls.[13] A reduction in total energy usage can be achieved by analyzing data related to room occupancy, peak ambient lighting levels throughout a building, and fluctuations in temperature during a 24-hour cycle, followed by the automation of environmental adjustments to incorporate verifiable energy requirements.

Spatial management capabilities are also positively impacted by the installation of a PoE system. With the elimination of line voltage, space requirements for the power supply's support infrastructure are reduced, improving the facility's capacity for space optimization and the accommodation of critical building systems. A recent study showed that up to 30% can be saved in energy and spatial management in large sites.[14]

4. Technology Expansion

At the physical layer, PoE enables technology expansion for network growth and integration of next-generation applications through a reliance on a standardized RJ45 connector interface across all networked devices, allowing joint data and power connections to be made in any part of a facility with category-rated cable infrastructure. Deployment of future devices via established network connections is effectively facilitated, reducing installation time for network expansion. This ease of device integration and low associated costs provide the opportunity for the addition of WAPs, advanced metrics-collecting devices, and other future-looking technology upgrades to support informed decision-making.

PoE's capacity for expansion to accommodate future-focused data and devices allows a business to leverage new technology, such as IoT, which connects intelligent networked devices into a single network. In addition, LED lighting fixtures can be powered using PoE technology. This allows the lighting to be intelligent in that it can capture occupancy data, be networked into building management systems which can control intensity of lighting in the room and also control when lights are on or off. This technology is anticipated to support next-generation applications such as Li-Fi, a high-speed, networked wireless communication technology that uses LED lighting to transmit data packets via light waves.

[13] "Cisco Digital Building Solution," Cisco Systems, Nikita Jain

[14] "Gartner Says Smart Cities Will Use 1.6 Billion Connected Things In 2016," Gartner, Dec. 7, 2015

5. Future-Proofed Networks

PoE provides a platform for enterprise network future-proofing, making it less costly to upgrade and expand over time. Systems that are consciously designed to meet current and emerging standards in concert with future network demands are highly upgradable. Such systems are demonstrably future-proofed, with the capacity to handle the demands of next-generation applications that will be incorporated into the network, including integrated building management systems, improved business security applications, and new business insight tools.

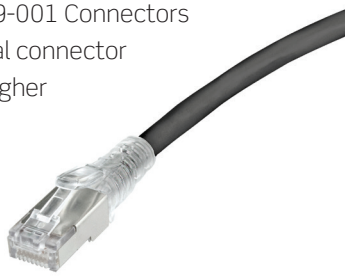
PoE is inherently scalable, as it is an Ethernet-based protocol, and can be readily expanded to meet the needs of a business as it grows. Migration to enhanced applications and future-facing building management systems responsible for security, environmental data collection, and facility-user behavior tracking will support informed decisions regarding future business operations and planning.

A recent Deloitte-MIT survey found that 80% of workers want to work at a digitally enabled company.[15] A business that implements future-focused network technology within a PoE-based framework proactively leverages this desire, and increases its ability attract and retain a talented labor force.

Preparing Existing Networks for High-Power PoE

As industry standards evolve and PoE-enabled devices continue to proliferate, PoE adoption will become more prevalent in enterprise applications. The capability to deliver 100-watt four-pair PoE, as described in the draft of IEEE 802.3bt scheduled for ratification in 2018, requires a robust copper cabling infrastructure and standards-compliant components. Leviton's end-to-end PoE-compatible system of cable, connectors, patch cords, and patch panels is component rated, and third-party tested and verified to exceed industry standard performance, including higher bandwidth and power levels. Atlas-X1 connectivity has successfully demonstrated readiness for 100-watt PoE, which will enable the transmission of power and data to a wide range of remote devices.

Leviton Atlas-X1™ Cat 6A connectors, which are the only UTP connectors on the market with a solid metal body, were tested for compliance with the IEC 60512-5-2 and 60512-99-001 Connectors for Electronic Equipment standards. This testing revealed that by using a metal connector body — instead of the more common ABS plastic — the connectors achieve higher performance and a 53% improvement in heat dissipation.



Leviton Atlas-X1 connectors are designed with PoE-optimized tine geometry that prevents tine damage that can be caused by higher current PoE applications. Leviton's patented Retention Force Technology (RFT™) maintains constant contact force at the connector and plug interface, preventing inadvertent intermittent disconnects caused by vibration or operational movement of the plug in the critical connector and plug mating region. This increases system longevity and prevents costly repairs.

Leviton Atlas-X1 Cat 6A SlimLine Patch Cords were tested for compliance with the TIA TSB-184A temperature rise limit of 15° C above ambient at 100 watts.

High-quality connectivity is essential for attaining the performance and reliability required for current and future PoE network operations. Leviton Atlas-X1 components are designed to meet or exceed industry standards for performance, ensure system longevity, and prepare networks for future upgrades and growth. This future-facing engineering will provide peak PoE performance today, and maximum flexibility for higher-power PoE deployment in the future.

Learn more about these solutions at Leviton.com/PoE.

[15] 2015 Digital Business Global Executive Study and Research Project, MIT Sloan Management Review and Deloitte University Press, 2015

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