



CAMPUS NETWORK

Solution Guide:

Deploying Brocade PoE and PoE+ Solutions in the Campus Network

Using the intelligent PoE/PoE+ capabilities of the Brocade FastIron family can ensure last-minute power to critical devices while saving operating costs.

BROCADE

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INTRODUCTION

Brocade® FastIron® switches provide Power over Ethernet (PoE) and Power over Ethernet Plus (PoE+) and are fully compliant with the IEEE 802.3af PoE and IEEE 802.3at PoE+ specifications for delivering in-line power. The IEEE 802.3af and 802.3at specifications define the standards for delivering power over existing network cabling infrastructure and providing multicast-enabled full streaming audio and video applications for converged services, such as Voice over IP (VoIP), WLAN access points, IP surveillance cameras, and other IP technology devices.

PoE technology eliminates the need for an electrical outlet and a dedicated Uninterrupted Power Supply (UPS) near IP-powered devices. With power sourcing equipment, such as Brocade FastIron switches, power is consolidated and centralized in wiring closets, improving the reliability and resiliency of the network. Because PoE can provide power over existing Ethernet cables, power is continuous, even during a power failure. Moreover, PoE provides several useful features to control, prioritize, and manage power precisely.

NOTE: In this document, the term PoE+ is used to reference both PoE and PoE+ unless specifically called out as one or the other. The following terms are also used:

- **Power Sourcing Equipment (PSE).** The source of the power or the switch that integrates the power onto the network. Power sourcing equipment has embedded PoE technology. In this case, the PoE switch is the Brocade FastIron family.
- **Powered Device (PD).** The Ethernet device that requires power and is situated on the other end of the cable from the power sourcing equipment. In this case, it includes devices such as IP phones, wireless access points, and cameras.

Since PoE generally powers the PDs placed on user desks or in buildings, PoE capability is needed in the campus network access layer only. Distribution and core switches do not need PoE capability. This guide highlights the design and deployment of PoE-based campus networks based on Brocade FastIron switches.

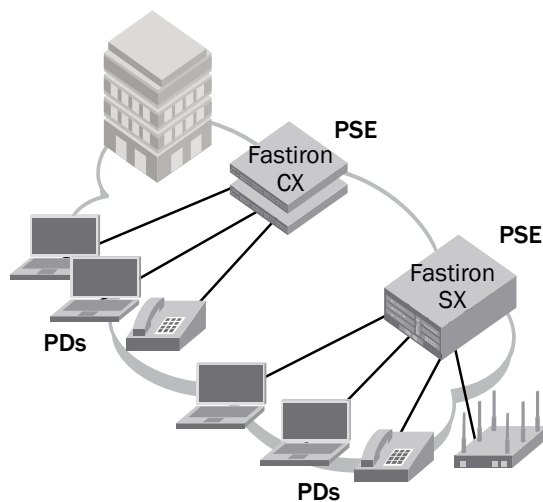


Figure 1. Campus network access layer: PSE and PD roles per IEEE 802.3af/at standards

PoE AND PoE+ STANDARDS

Brocade FastIron switches support both IEEE 802.3af PoE and the newer IEEE 802.3at PoE+ standard. The PoE standard defines power classes for up to maximum of 15.4 watts (W) of power at the PSE ports. The actual PD gets about 12.95W of power after power dissipation (loss) over the copper wire. This is in compliance with safety standards and existing wiring limitations. Though limited by the 802.3af standard, 15.4W of power is ample, as most powered devices consume an average of 5 to 12W. IP phones, wireless LAN access points, and network surveillance cameras each consume an average of 3.5 to 9W. An off-the-shelf PD should belong to one of the classes defined by the PoE standard shown in Table 1.

Table 1. IEEE 802.3af PoE standard classes

Standard	PoE Class	Usage	Min Power (W) at PSE	Max Power (W) at PD
802.3af	0	Default	15.4	0.44 - 2.95
	1	Optional	4	0.44 - 3.84
	2	Optional	7	3.84 - 6.49
	3	Optional	15.4	6.49- 12.95
	4	Unused		

The IEEE 802.3at PoE+ (also called High Power) standard doubles the power at the PSE ports to a maximum of 30W, with the PD actually getting about 25.95W. The PoE+ standard is defined in anticipation of a next-generation class of PDs, which may require higher power than 15.4W. Existing examples of these PDs are 802.11n Wireless Access Points (APs). When high-power outdoor antennas are used over longer distance, 802.11n APs may demand more power from the PSE than regular PoE can supply. An ordinary PoE-only switch may decline such a request and the PD may not function properly. A PoE+-capable PSE, such as Brocade FastIron CX switches, can easily accommodate such power requirements, enabling next-generation IP endpoints and future proofing networks for applications to come. As more advanced PDs such as video IP phones and pan-tilt-zoom cameras are deployed in more media-rich campus environments, the full potential of PoE+ will be exercised.

The new PoE+ standard is a superset of the legacy PoE standard, so switches supporting PoE+ by default support legacy PoE capability as well. This is accomplished by bundling legacy PoE classes 0 through 3 (Type 1) and using the unused class 4 for high power (Type 2). Table 2 shows Table 1 from the PoE+ standard point of view. Table 3 compares the two standards side by side.

Table 2. IEEE 802.3at PoE+ standard classes

Standard	PoE+ Class	Usage	Min Power (W) at PSE	Max Power (W) at PD
802.3af (Type1)	0	Default	15.4	0.44 - 2.95
	1	Optional	4	0.44 - 3.84
	2	Optional	7	3.84 - 6.49
	3	Optional	15.4	6.49 - 12.95
802.3at (Type2)	4	Optional	30	12.95 - 25.5

Table 3 compares PoE and PoE+ side by side on a number of different parameters.

Table 3. IEEE 802.3af PoE and 802.3at PoE+ side by side

Feature	802.3af PoE	802.3at PoE+
Cable Requirement	Category 3 or Category 5	Type 1: Category 3 Type 2: Category5/5E
PSE Current (A)	0.35	Type 1: 0.35 Type 2: 0.60
PSE Voltage (Vdc)	44 - 57	Type 1: 44 - 57 Type 2: 50 - 57
PD Current (A)	0.35	Type 1: 0.35 Type 2: 0.60
PD Voltage (Vdc)	37 - 57	Type 1: 37 - 57 Type 2: 47 - 57
Maximum PD Wattage (W)	Class 0, 3: 12.95 Class 1: 3.84 Class 2: 6.49 Class 4:Unused	Type 1: Class 0, 3: 12.95 Class 1: 3.84 Class 2: 6.49 Type 2: Class 4: 25.5
PD Classification Requirement	Optional 1-Event Classification	Required Type 1: 1-Event Classification Type 2: 2-Event Classification and LLDP

NOTE: The 802.3at standard currently supports POE+ on 10/100/1000 Mbps Ethernet ports operating over standard Category 5 Unshielded Twisted Pair (UTP) cable or better. If your network uses cabling categories lower than 5, you cannot implement PoE+ without first upgrading your cables to CAT 5 UTP or better.

CAMPUS NETWORK REFERENCE MODEL

Figure 2 is a reference diagram for the enterprise campus network and shows where Brocade IP products are generally positioned. This is simply one of several reference designs for Brocade products in an enterprise campus network scenario.

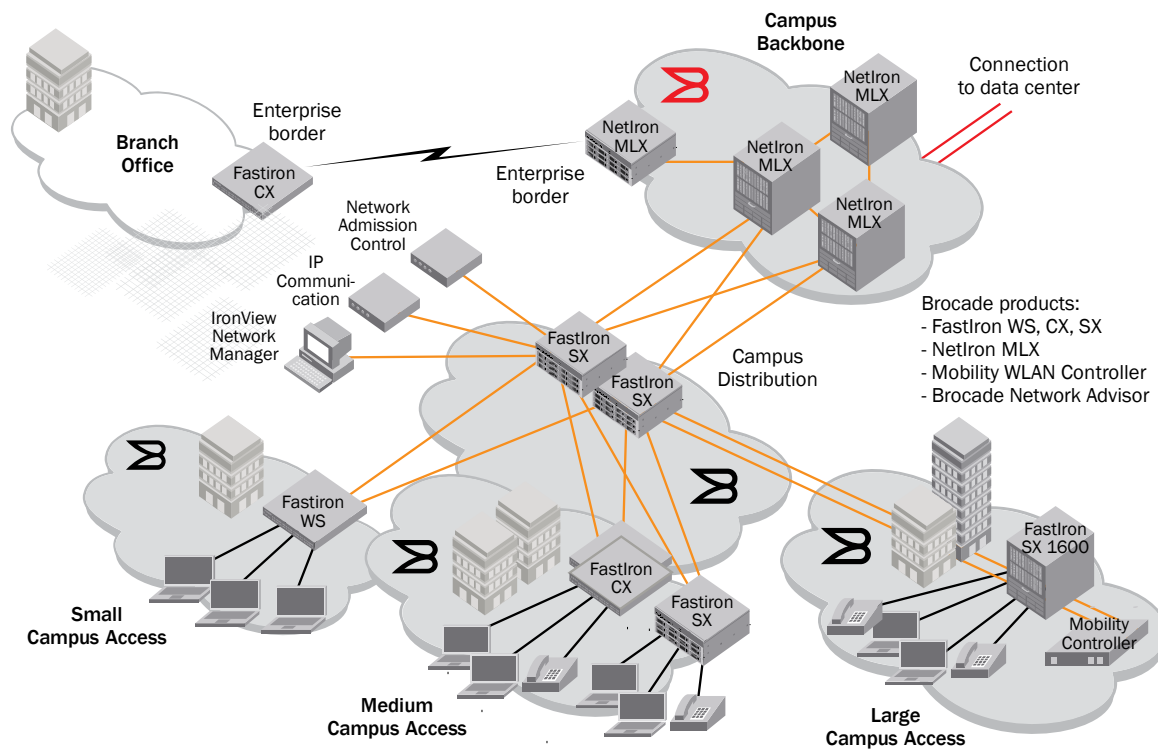


Figure 2. Enterprise campus network reference model

Campus Access

The access layer is where laptop or desktop computers, workstations, VoIP phones, and WLAN access points are connected to “access” the network services. Collaboration services, such as voice and video conferencing equipment and video surveillance cameras, are also connected at this layer. This layer is often referred to physically as the “wiring closet”. Access-level security, Quality of Service (QoS), and PoE are implemented at this layer. The Brocade FastIron family of PoE/PoE+-capable switches are most commonly deployed in this layer of the campus network.

Campus Distribution

The distribution layer (sometimes known as the aggregation layer), aggregates multiple access layer switches and connects them to the campus core. This layer deals with complex security, Access Control List (ACL), scalability, QoS, STP, and so on. Usually each access switch is dual connected to this layer for high availability. Brocade BigIron RX Series or FastIron SX Series switches are most commonly deployed at this layer of the campus network.

Campus Core

Also known as the “backbone”, the core layer consists of high-speed, high-performance, high-availability switches that interconnect user segments and provide connectivity to both data center services and the outside world. Brocade NetIron MLX Series routers are most commonly deployed at this layer of the campus network.

DEPLOYING BROCADE POE-BASED SOLUTIONS

Getting Ready for PoE

Before you can actually deploy PoE, it is important to calculate the power budget and to carefully plan the environment. A good starting point is to calculate the total number of end devices (PDs) that need to be powered up by a Brocade switch (PSE) and divide them by the power class to which they belong. All end devices such as IP phones, access points, and cameras can be treated the same way with regards to PoE. Table 4 is an example of how to calculate power consumption.

Table 4. PoE port density calculation

Switch	Class-1 PD (4W)	Class-2 PD (7W)	Class-3 PD (15.4W)	Class-4 PD (30W)	Total
First Floor Access	0	10 <i>70W</i>	5 <i>77W</i>	1 <i>30W</i>	<i>177W</i>
Second Floor Access	0	55 <i>385W</i>	80 <i>432W</i>	0 <i>0W</i>	<i>817W</i>

Creating a table like this helps you prepare you for the total power requirements as well as for circuit planning for the site. It is recommended that you talk to your Brocade representative for access to a Power Calculator tool for precise power requirements calculations.

Selecting Brocade PoE/PoE+-Ready Products

Once the port density and power requirements have been determined, the next step is to select the appropriate Brocade PoE product to suite your needs. Brocade offers a range of PoE switches and PoE port densities in fixed and modular form factor to build small to very large scale campus networks, as shown in Figure 3.

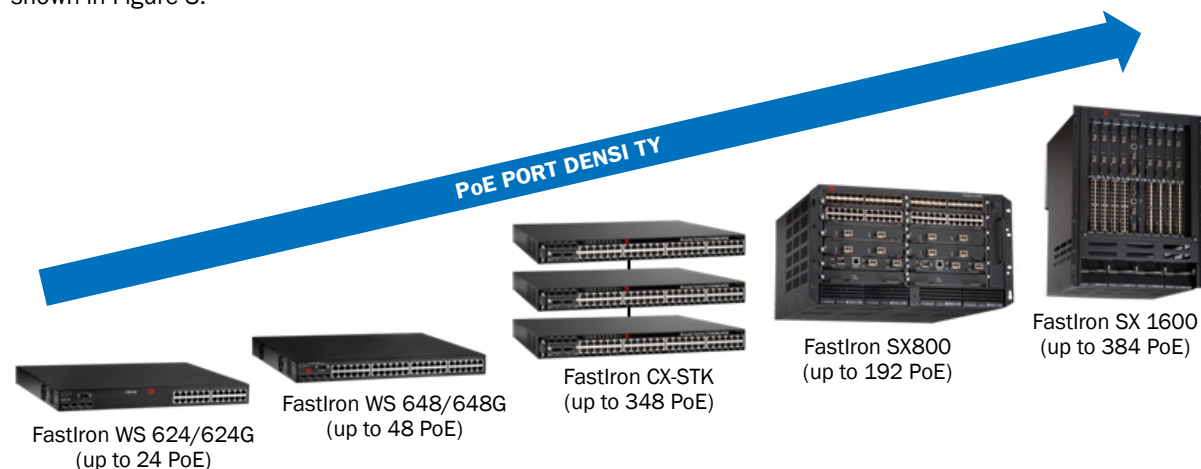


Figure 3. Brocade FastIron family of PoE and PoE+ products

FastIron WS Series

The Brocade FastIron WS Series is a complete line of 1U enterprise-class Layer 2/ Layer 3 switches. The FastIron WS Series extends the Brocade broad edge-to-core networking portfolio with a value line of intelligent edge switches designed for Small and Medium Business (SMB), branch offices and distributed enterprises with changing business needs. FastIron WS switches are available in 24- and 48-port 10/100 or 10/100/1000 Mbps models, with or without IEEE 802.3af PoE, for enterprise edge networking, security, and unified communication needs.

Featuring standards-based PoE, the FastIron WS delivers the scalability, QoS, resilience, and VoIP readiness —to implement a converged solution at the network edge. Combining Fast Ethernet, Gigabit Ethernet (GbE), PoE, and intelligent fault detection with a feature-rich, secure, highly reliability solution, the FastIron WS Series offers high productivity and investment protection. This cost-effective, compact solution enables the deployment of new applications such as IP telephony, wireless access, and building management systems.

FastIron CX Series

The Brocade FastIron CX Series provides new levels of performance, scalability, and flexibility demanded by the modern enterprise campus LAN. With advanced capabilities, such as dedicated 16 GbE stacking ports and optional 10 GbE uplink ports, the FastIron CX Series enables businesses to deliver performance and intelligence to the network edge in a flexible, small form-factor solution, while reducing infrastructure and administrative costs.

These switches can deliver power, along with data, across the network connection, providing campus edge devices such as VoIP phones, video surveillance cameras, and wireless access points with a single cable solution. These switches support the emerging PoE+ Plus standard (802.3at) to provide up to 30W of power to each device. This high powered solution enables simplified wiring for next generation solutions such as video conferencing phones, pan/tilt surveillance cameras, and wireless 802.11n access points. PoE+ allows for reduced power receptacles, fewer power adaptors, increased reliability, and greater wiring flexibility.

The 24-port FastIron CX supplies full Class 3 (15.4W) or full PoE+ (30W) of power to every port. The 48-port FastIron CX supplies full Class 3 power to every port, full PoE+ power to 26 ports, or a combination of the two staying within the switches 820W power budget.

FastIron SX Series

The FastIron SX Series extends control from the network edge to the backbone with intelligent network services, including superior QoS, predictable performance, advanced security, comprehensive management, and integrated resiliency. The FastIron SX Series has an extensive feature set, making it well suited for real-time collaborative applications, IP telephony, IP video, e-learning, wireless LANs—all of which can raise an organization's productivity. The FastIron SX delivers wire-speed performance and ultra-low latency, which are ideal for converged network applications such as VoIP and video conferencing. These platforms offer the industry's most scalable and resilient PoE design, with a robust feature set to secure and simplify the deployment of an edge-to-core converged network. In addition, the FastIron SX supports high-density 10 GbE for enterprise backbone deployments.

The FastIron SX features a unique power distribution design for the system and PoE power. The chassis are designed with independent systems and PoE power subsystems. This design achieves optimal power operation and configuration, reducing the equipment and ongoing costs, in comparison to modular systems that use a common power supply for both the systems and the PoE equipment. In the FastIron SX, the power consumption of a line module's PoE circuitry does not impact the system power. Similarly, the power consumption of the line, switch, and management modules does not impact the PoE power.

The FastIron SX Series provides up to N+1 System and N+1 PoE power redundancy. Power consumption for the system and PoE are calculated, provisioned, and managed independently of one another. As more PDs are added to a switch, a simple power budget calculation determines whether another PoE power supply needs to be added to the switch. This dual-distribution power design simplifies the power configuration of the system while enhancing system reliability.

Selecting PoE/PoE+ Powered Devices

The Brocade FastIron family of POE/PoE+ switches support many different types of IP-powered devices, including:

- Voice over IP (VoIP) phones
- Wireless LAN access points
- IP surveillance cameras

IP Phones and Audio Conferencing

Since Brocade switches are fully IEEE PoE and PoE+ standards compliant, any PD that is compliant with these standards can be seamlessly plugged and powered with Brocade PoE switches. This opens up the whole range of end devices for organizations and eliminates the single vendor lock. Figure 4 shows a few of the industry-leading IP phones that can be deployed with the Brocade FastIron family of switches.



Figure 4. Wide range of industry-leading VoIP phones supported by the Brocade FastIron family of switches

Brocade PoE switches are tested with the most popular IP phones in the industry—including Avaya, Mitel, ShoreTel, Microsoft, Nortel, and Cisco. Some of the solutions and IP devices from these vendors are tested, certified, and recommended by Brocade as a preferred solution partner. For more information, visit [VoIP Solutions](#) on [www.brocade.com](#).

Video Conferencing

The Brocade FastIron family of PoE switches enable enterprises to use collaboration services such as video conferencing in the workplace to collaborate among remote virtual teams and enterprise branch offices for improved productivity. Brocade FastIron switches provide the performance and intelligence necessary for two-way video communication and can be used with variety of video conferencing equipment such as LifeSize, Polycom, and Tanberg.

Wireless Access Points

Although any 802.11 series Access Point (AP) can be used with Brocade PoE switches, Brocade Mobility APs can be managed as a single device by Brocade Network Advisor, a network management tool that manages Brocade devices across the network. For more information about Brocade Mobility APs and Mobility security, visit [Brocade Mobility](#) on [www.brocade.com](#).

Many new 802.11n access points demand more than the 12.95W of power that a Class 3 PoE switch can deliver all the way to the device. The new Brocade FastIron CX series switches with PoE+ can deliver up to 25.5W all the way to the device, providing these new access points with the power that they need.

IP Surveillance Cameras

IP surveillance technology provides digital streaming of video over Ethernet, providing real-time, remote access to video feeds from cameras. Surveillance cameras are often installed in locations where power receptacles are not accessible or cannot be installed. Running data communication and power over a single Ethernet cable provides the flexibility to optimize the surveillance network. Any surveillance camera that is IEEE standard compliant can be powered with Brocade PoE switches.

Designing for High Availability

In every organization, some business critical devices need to stay up and running 24x7. Organizations that need this high availability include hospital environments, emergency responders, and important decision makers in defense and other deployments. Design best practices to ensure that those users are identified and the network is architected for availability even in the event of a natural or other disaster.

Use the Brocade PoE prioritization feature and assign these ports a *Critical* PoE priority so that they stay up when there is not enough PoE power budget. Put those users on the switches with power backup systems and redundant PoE power supplies. Brocade FastIron family provides 1+1 PoE power supply redundancy in fixed form factor and N+1 PoE power supply redundancy in modular form factor switches. To increase availability, put each PoE power supply on a different power circuit so that in case of a circuit trip, critical ports stay up. With good design and help from advanced PoE capabilities in FastIron products, you can deploy a converged network that will ensure your users have services available when they need them most. The following sections describe PoE features in Brocade FastIron switches.

BROCADE FASTIRON POE FEATURES

Brocade FastIron family of PoE switches support the following PoE features in general. Refer to the product documentation, specifically the *Configuration Guide*, to confirm whether or not a feature is supported on a particular FastIron product or release.

PoE Autodiscovery and Classification

PoE Autodiscovery is a detection mechanism that identifies whether or not an installed powered device is 802.3af or 802.3at compatible. When you plug a device into an Ethernet port that is capable of providing in-line power, the Autodiscovery mechanism detects if the device requires power and if so, how much power is needed. Autodiscovery also has a disconnect protection mechanism that shuts down the power when a powered device has been disconnected from the network or a faulty powered device is detected.

This feature enables safe installation and prevents high-voltage damage to the powered devices. PoE Autodiscovery is achieved by periodically transmitting current or test voltages that can detect when a powered device is attached to the network. When an 802.3af-compatible device is plugged into a PoE port, the powered device reflects test voltage back to the power sourcing device (the Brocade device), ultimately causing the power to be switched on. Non-compatible 802.3af/at devices do not reflect test voltage back to the power sourcing device.

Brocade switches use the 1-event or 2-event classification mechanism defined by the 802.3at standard to distinguish between a legacy PoE and a PoE+ device. Different power classes determine the amount of power a PoE-powered device receives. When a valid powered device is detected, the Brocade PoE switch performs power classification by inducing a specific voltage and measuring the current consumption of the powered device. Depending on the measured current, the Brocade device assigns the appropriate class to the powered device. Powered devices that do not support classification are assigned a class of 0 (zero).

Detection of PoE Power Requirements

There are two ways for the powered devices to dynamically request the PoE power from the PSE—proprietary protocols such as the Cisco Discovery Protocol (CDP) used by Cisco IP phones or the standard-based Link Layer Discovery Protocol (LLDP) used by variety of IP phones and access points. Brocade switches support both methods but recommend the latter because it does not limit organizations to a single class of powered devices and because LLDP provides a lot of additional features. Some powered devices such as Cisco IP phones use CDP to advertise their power requirements to PSEs such as Brocade's PoE switches. Brocade PoE switches support such powered devices and can detect and process power requirements for these devices automatically.

The Brocade FastIron PoE switches support IEEE 802.1AB LLDP and ANSI TIA 1057 LLDP-MED standards, enabling organizations to build open-convergence, advanced, multi-vendor networks that enable a variety of PDs to be plugged with Brocade switches. LLDP is a Layer 2 network discovery protocol described in the IEEE 802.1AB standard. This protocol enables a device to advertise its capabilities to and to discover other LLDP-enabled devices in the same 802 LAN segments.

LLDP Media Endpoint Devices (LLDP-MED) is the Layer 2 network discovery protocol extension to LLDP described in the ANSI/TIA-1057 standard. This protocol enables a PoE switch to configure and manage connected powered devices that need to send media streams across the network (for example, IP phones and security cameras). LLDP enables network discovery between network connectivity devices (such as switches), whereas LLDP-MED enables network discovery at the edge of the network, between network connectivity devices and media endpoint devices (such as IP phones).

LLDP greatly simplifies and enhances network and asset management and network troubleshooting, while LLDP-MED addresses the unique needs that voice and video demand in a converged network by advertising media and IP telephony-specific messages exchanged between the network and the endpoint devices. LLDP-MED provides exceptional interoperability, IP telephony troubleshooting, and automatic deployment of policies, inventory management, advanced PoE power negotiation, and E911 location/emergency call service. These sophisticated features make converged network services easier to install, manage, and upgrade and significantly reduce operations costs. LLDP-MED provides the following benefits:

- Vendor-independent management, enabling different IP phones to interoperate in one network
- Automatic deployment of network policies, such as Layer 2 and Layer 3 QoS policies and voice VLANs
- E-911 Emergency Call Services (ECS) for IP telephony
- Endpoint inventory information collection
- Network troubleshooting
- Improper network policy configuration detection

Setting the Maximum Power Level for a PoE Powered Device

There are two ways to configure the power level for a PoE-powered device on Brocade PoE switches. For each PoE port, you can configure either a maximum power level or a power class. You cannot configure both. You can, however, configure a maximum power level on one port and a power class on another port.

The power class sets the maximum power level for a powered device indirectly according to IEEE standards. The power class includes any power lost through cables. For example, a PoE port with a default power class of 0 (15.4W) receives a maximum of 12.95W of power after 2.45W of power loss through the cable. This is compliant with the IEEE 802.3af specification for delivering in-line power. Devices that are configured to receive less PoE power, for example, class 1 devices (4.0W), experience a lower rate of power loss through the cable. Alternatively, you can set the maximum power level directly on a PoE port in watts.

PoE Power Prioritization for a PoE Port

In a configuration in which PoE-powered devices collectively have a greater demand for power than the PoE power supply can provide, a Brocade PoE switch must place the PoE ports that it cannot power in either *standby* or *denied* mode (waiting for power) until the available power increases, that is, when one or more PoE ports are powered down or an additional PoE power supply is installed in the switch. When PoE ports are in standby or denied mode and the Brocade PoE switch receives additional power resources, by default the switch allocates newly available power to *the standby ports* in ascending order—first by slot number and then by port number, provided enough power is available for the ports. For example, PoE port 1/11 receives power before PoE port 2/1. However, if PoE port 1/11 needs 12W of power and PoE port 2/1 needs 10W, and 11W of power become available on the device, the switch allocates the power to port 2/1 since it does not have sufficient power for port 1/11.

You can configure an *in-line power priority* on Brocade switch PoE ports, whereby ports with a higher in-line power priority take precedence over ports with a low in-line priority. For example, if a new PoE port comes online, the port is configured with a high priority and power is already fully allocated to powered devices, the switch removes power from PoE ports with a lower priority and allocates it to PoE port with the higher value.

Ports that are configured with the same in-line power priority are given precedence based on the slot number and port number in ascending order, provided enough power is available for the port. For example, if both PoE port 1/2 and PoE port 2/1 have a high in-line power priority, PoE port 1/2 receives power before PoE port 2/1. However, if PoE port 1/2 needs 12W of power, PoE port 2/1 needs 10W, and 11W of power become available on the device, the Brocade PoE switch allocates the power to PoE port 2/1 since it does not have sufficient power for port 1/2.

NOTE: By default, all ports are configured with a low in-line power priority and can be configured to medium or high power priority.

PoE Scheduled Shutdown

The Brocade FastIron family of PoE switches can be configured to turn the PoE in-line power on specified ports on or off through Brocade IronView Network Manager (INM) management software. This feature is extremely useful to turn off the PoE power during non-business hours, weekends and holidays, reducing operating costs.

PoE Power Isolation

The Brocade FastIron modular products feature a unique power distribution design for the system and PoE power. Chassis are designed with independent system and PoE power subsystems. This design achieves optimal power operation and configuration, reducing equipment and ongoing costs compared to modular systems that use a common power supply for both systems and the PoE equipment. In the FastIron modular family, the power consumption of a line module's PoE circuitry does not impact the system power. Similarly, the power consumption of the line modules, switch modules, and management modules does not impact the PoE power. Power consumption for the system and PoE are calculated, provisioned, and managed independently of one another. As more PDs are added, a simple power budget calculation determines whether another PoE power supply needs to be added to the switch. The system power distribution and the PoE power distribution subsystems are each designed for M+N load-sharing operation on the modular products. This dual-distribution power design simplifies the power configuration of the system while enhancing system reliability.

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