Cisco Aironet Power over Ethernet Application Note

Introduction

The goals of this document include the following:

- Identify Cisco inline-powered WLAN devices and their usage requirements with a Cisco inline-powered switch, mid-span device, or injector-powered solution.
- Help identify compatibility to enable the selection of the appropriate powered solution for the deployed device.
- Identify implementation requirements for all Cisco WLAN products that operate from inline power via Cisco pre-standard power, IEEE 802.3af, and the emerging 802.3at standard.

Types of Power over Ethernet

This section describes various types of Power over Ethernet (PoE) including Cisco pre-standard power, IEEE 802.3af power, and IEEE 802.3at power.

Cisco Pre-Standard Power

The first generation of Cisco pre-standard PoE was designed to power devices such as Cisco IP phones and access points. This pre-standard solution had relatively low power requirements (approximately 6 to 7 watts). Later generations of pre-standard power supported higher power modes (up to 15 Watts) and added power negotiation via Cisco Discovery Protocol (CDP). In July 2003, the IEEE ratified the 802.1af standard (up to 15.4 watts of power). With the ratification of IEEE 802.3af, Cisco supports both IEEE 802.3af and Cisco pre-standard PoE concurrently. Cisco has also extended pre-standard power management using CDP negotiation to Cisco IEEE 802.3af compliant devices to further optimize Power Source Equipment (PSE) power management.

When using a Cisco pre-standard source for power, it is important to check the power draw in watts (Table 1) and verify that the PSE can supply enough wattage to the powered device. Depending on the version of your PSE, enough power may not be available to supply some of the newer access points.

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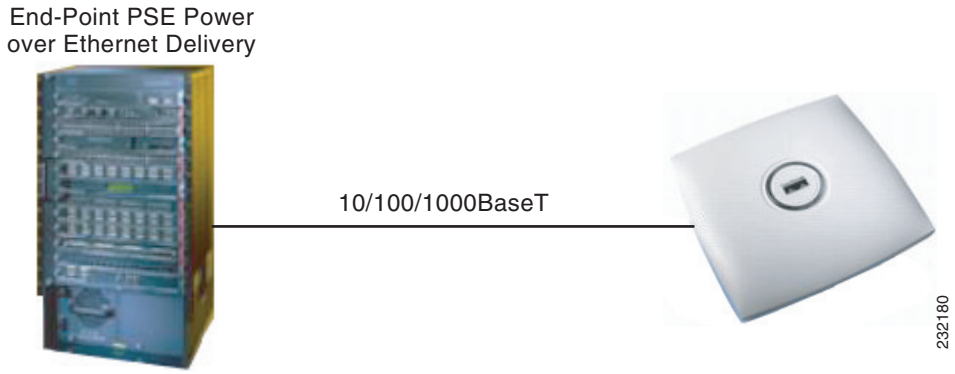
IEEE 802.3af Power

The IEEE 802.af-2003 PoE standard:

- Defines terminology to describe a port that acts as a power source to a powered device.
- Defines how a powered device is detected.
- Defines two methods of delivering PoE to the discovered device requiring power.
  - End-Point PSE—PoE-capable Ethernet port. Power may be delivered by an end-point PSE to a powered device using the active data wires of an Ethernet port or the spare wires. An end-point PSE, such as a PoE-capable Ethernet switch may implement either scheme.
  - Mid-span PSE—Can be used to deliver PoE if an existing non-PoE-capable Ethernet switch is used. If a mid-span PSE is used, it can only implement power delivery over the spare pairs of the copper cabling and cannot be used to deliver PoE over 1000BASE-T connections.

Note Only one mechanism may be used at a time to deliver power to a powered device because the design of the device.

Figure 1 End-Point PSE PoE Delivery



Power delivery, supported within Cisco Catalyst Ethernet switches, relies on the data pairs (pins 1-2 and 3-6) to transmit power (sometimes referred to as “phantom” power). The second mechanism relies on the unused data pairs (pins 4-5 and 7-8) to deliver power that is supported within mid-span power delivery.

IEEE 802.3at Power

In September 2005, the IEEE began work on a higher power standard for PoE. This standard has not yet been ratified. Unlike 802.3af (which has a limit of 15.4 watts and must work with the limitations of Category 3 cable), IEEE twice the PoE power support (approximately 30 watts using two pairs).

Although still in discussion, the standard may include PoE power support as high as 60 watts (using four pairs). The main purpose of 802.3at is to enable more power to operate over an Ethernet cable. Additionally, the task force has agreed to allow gigabit mid-span products and has granted them the ability to choose either active data pairs or spare pairs for the power delivery.

Note A 1000BASE-T mid-span device is a product in the middle of the circuit that can provide power. This product can be a powered Ethernet source, an injector, or other mechanism for inserting PoE.

PoE Requirements for Cisco Access Points

To determine if a particular switch or PSE can supply enough power to an access point, the installer needs to verify the amount of power the access point draws and confirm that there is enough power present to operate it. Depending on the make, model, and radio configuration, the access point can draw different amounts of power. Table 1 presents the power requirements (in watts) for Cisco Aironet access points.

Table 1 Cisco Aironet Access Point Power Requirements (in watts)

Cisco Aironet Access Point	Access Point Input Power	PSE Output Power (considers cable loss)****
350/BR350	5.750	6.000
521 with 802.11g radio (802.3af compatible)	9.900	9.910
1000 with both 802.11a/g radios (802.3af compatible)	6.700	6.750
1120 with 802.11b radio	4.750	4.900
1121 with 802.11g radio	4.750	4.900
1130 with 802.11g radio (802.3af compatible)	9.900	9.910
1130 with 802.11a and 802.11g radios (802.3af compatible)	11.10	12.20
1200 without installed radios	4.30	4.42
1200 with 802.11b radio	6.00	6.24
1200 with 802.11g radio	6.20	6.460
1200 with 802.11a (RM20) black stripe paddle antenna	8.00	8.50
1200 with 802.11a (RM21) white stripe paddle antenna (or RM22)	9.50	10.14
1200 with 802.11a (RM20) and 802.11b radio	10.80	11.64
1200 with 802.11a (RM20) and 802.11g radio	10.20	10.95
1200 with 802.11a (RM21) and 802.11g radio	11.20	12.12
1200 with 802.11a (RM21) and 802.11g radio	11.40	12.36

Table 1 Cisco Aironet Access Point Power Requirements (in watts)

Cisco Aironet Access Point	Access Point Input Power	PSE Output Power (considers cable loss)****
1240 with 802.11g radio (802.3af compatible)	11.40	12.960
1240 with 802.11a and 802.11g radios (802.3af compatible)	12.95	15.00
1250 without installed radios	9.00	9.00
1250 with a single radio either 802.11a/n or 802.11bg/n	12.95	15.4
1250 with both 802.11a/n and 802.11bg/n radios**	16.5	18.5
1260 with both 802.11a/n and 802.11bg/n radios	15.4	15.4
3500 with 802.11n antennas	15.4	15.4
3600 with 802.11n antennas***	15.4	15.4

* 1250 with one radio: 802.3af compatible.

** 1250 with two radios: beginning late 2007, Cisco will enable auto-negotiating, single-port power for the Cisco Aironet 1250 Access Point on leading switches across the Catalyst portfolio.

*** 3600 with a module attached uses 802.3at. The module will not be enabled when 802.3af power source is used.

**** PSE value in watts is the value the power device will use for CDP.

The figures used in Table 1 were calculated as described below in Figure 2.

Note The power requested for the switch/box by the access point must take into account the resistance of 100 m of Category 5 Ethernet cable.

Figure 2 Power Calculation Formula for PSE

$$\text{PowerPSE} = \frac{V^2 - \sqrt{V^4 - (4 \cdot R \cdot V^2 \cdot \text{PowerPD})}}{2 \cdot R}$$

V = voltage, R = resistance of cable (Ohms), PowerPD = power Consumed by the access point (W)

The worst case voltage is 40 V. The resistance of the Category 5 cabling is in Ohms.

Note Always check the power specifications of the PSE (switch, mid-span power, or injector) to confirm that it can support the access point you are deploying. If the PSE cannot supply enough power, the access point radios may be disabled or the access point may repeatedly "reboot" as the device draws more power than the PSE can supply. This imbalance trips the breaker causing it to reset as the breaker cools down and causes the access point to appear to be cycling or rebooting.

Using a Cisco Power Injector

In environments with fewer installed access points, it may be more cost effective to use a Cisco Power Injector. Table 2 is a guide to assist with selecting the correct power injector.

Table 2 Cisco Power Injectors and the Supported Access Points

Cisco Aironet Access Points	Power Injector
350-BR350 series* (old injector AIR-PWRINJ=)	AIR-PWRINJ3
1000 series	AIR-PWRINJ-1000AF
1100/1120 series* (old injector AIR-PWRINJ2=)	AIR-PWRINJ3
1130 series*	AIR-PWRINJ3
1200 series* (old injector AIR-PWRINJ1200=)	AIR-PWRINJ3
1240 series*	AIR-PWRINJ3
1250 series	AIR-PWRINJ4
1260 series	AIR-PWRINJ4=
3500 series	AIR-PWRINJ4=
3600 series	AIR-PWRINJ4=
BR1300 series	AIR-PWRINJ-BLR2=
BR1300 series (when operation from +12 VDC is desired)	AIR-PWRINJ-BLR2T=
BR1400 series	AIR-PWRINJ-BLR1=
1500 series	AIR-PWRINJ-1500=
1520 series	AIR-PWRINJ-1500-2=
* These units can also support the powered fiber injector	AIR-PWRINJ-FIB=

Powering the Cisco Aironet 1250 Series Access Point in High Power (18.5-Watt Mode)

Powering access points with additional features such as radio modules may cause the access point to exceed 15.4 watts (the limits of 802.3af). There are several short-term ways to solve this problem.

Note Only use ONE source of power at any time.

1. Deploy using local power such as the Cisco Power Supply (AIR-PWR-SPLY1=)
2. Deploy using a mid-span device such as a Cisco Power Injector (AIR-PWRINJ4=)
3. Deploy on applicable Catalyst switches using Cisco Intelligent Power Management (See Figure 3).

Figure 3 Power from a Cisco Catalyst Switch Using Cisco Intelligent Power Management

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