

Cisco Unified IP Phones: Conserve Energy with Intelligent Power Allocation

When evaluating unified communications options, organizations are increasingly considering the environmental effect of these solutions. Communications equipment that uses the Power over Ethernet (PoE) standard often allocate more energy than necessary for two reasons: First, the power categories defined by IEEE 802.3 PoE are very coarse and often result in the overestimation of power requirement; and second, the IEEE 802.3 PoE does not allow changes to the allocated power levels, so equipment must allocate based on maximum power usage rather than actual power requirements. The Cisco® Discovery Protocol allows PoE devices such as Cisco Unified IP Phones to intelligently collect power-consumption information and communicates that information to the Cisco switches supplying the power.

This paper explains how switch power allocation, handled through Cisco Discovery Protocol, allows an organization's systems to efficiently manage power budget for Cisco Unified IP Phones across switch ports. You will learn more about power consumption in a Cisco Unified Communications environment and how with its market-leading, feature-rich line of IP phones, Cisco continues to be a leader in providing solutions for fixed and mobile workspaces that are optimized for efficient power consumption.

Power over Ethernet Classifications

In March 2000, well ahead of the Power over Ethernet industry standards, Cisco released the first set of switches and phones that used PoE. In June 2003 the IEEE ratified the 802.3af specification, which defined the industrywide standard for device detection and delivery of PoE. Table 1 gives the classifications of the 802.3af standard.

Table 1. Standard 802.3af Classifications

Standard 802.3af Class	Maximum Power (W)	Class Description
3	15.40	Up to full power
2	7.00	Medium power
1	4.00	Low power
0	15.40	Default

The classification process uses a look-up table to assign a class (0–3) based on the direct current measurement.

However, the 802.3af classifications are inflexible because peak power usage is based on classification instead of negotiation. After initial device power-up, power requirements cannot be adjusted. Consider a device that has a Class 3 rating. The power sourcing equipment (PSE) will allocate 15.4W of power, even though the device may have a peak consumption of 7.2W of power, representing an overbudgeting of twice the amount of power actually needed. This overallocation would result in the PSE supporting significantly fewer devices than it has available power capacity

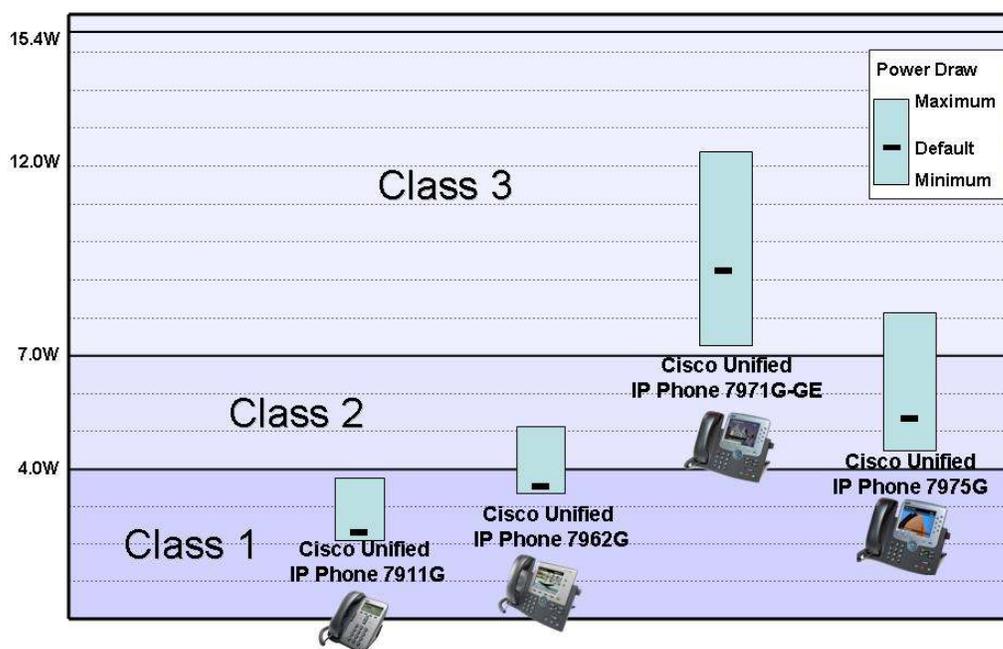
for. In this example, if the Cisco Unified IP Phone could indicate the peak power usage after the 802.3af negotiation, a Cisco switch or router would be able to save 50 percent of the power allocated for a port when connected to a Cisco Unified IP Phone.

Cisco Discovery Protocol Power Negotiation

When deploying only 30 to 40 IP phones, the overbudgeting of the power requirements based on the class of a device may or may not be significant. But when considering a deployment of 10,000 phones, the standard PoE power classification may reduce the total number of devices that could be supported on a switch or other power-sourcing device. To more effectively manage power budgeting for Cisco Unified IP Phones when connected to a Cisco switch, the Cisco Discovery Protocol is used to communicate a more accurate power-requirement value to the connected switch. In fact, select Cisco switches can deliver power to other switches, wireless access points, IP cameras, PoE speakers, and PoE digital clocks. The use of Cisco Discovery Protocol does not affect the 802.3af discovery process, but instead downwardly adjusts the amount of power allocated on the switch port so that additional devices can be supported.

For example, the Cisco Unified IP Phone 7911G is an 802.3af Class 2 device. At their peak power level, Class 2 devices may draw 7.0W of power from the PSE. But after the Cisco Unified IP Phone 7911G powers up and is classified as a Class 2 device, it exchanges Cisco Discovery Protocol with a Cisco switch and the phone reports a maximum peak power of 5.0W. This change represents an immediate 29-percent adjustment in the PSE power budget. When measuring the actual power consumption of the Cisco Unified IP Phone 7911G after it has registered with a call-processing server (using the factory defaults), the phone consumes only 2.3W of power. This amount represents a 54-percent difference between the Cisco Discovery Protocol reported value and the actual usage, and a 67-percent difference from the 802.3af classification.

Figure 1. Cisco Discovery Protocol for Cisco Unified IP Phones



The images in Figure 1 represent the maximum power that these devices theoretically consume, with a safety margin added. Cisco took a very conservative approach in deriving the power values used in Cisco Discovery Protocol to help ensure maximum reliability. For instance, if the Cisco Discovery Protocol power value was set to the calculated or observed peak power level by the phone, then any slight deviation could cause a power overdraw on the switch port. When there is a power draw over the allocated amount, the port shuts down and therefore removes power to the device, resulting in the phones being rendered unavailable for use. In reality, a phone consumes significantly less power than that specified in the Cisco Discovery Protocol value (Table 2).

Table 2. Cisco Unified IP Phone Power Consumption

Cisco Unified IP Phone Model	Standard 802.3AF Classification	Cisco Discovery Protocol (W)	Idle (W)	Maximum Power Consumption (W)
7911G	7.00W (Class 2)	5.00	2.30	3.71
7941G and 7961G	7.00W (Class 2)	6.30	3.84	4.95
7942G and 7962G	7.00W (Class 2)	6.30	3.84	4.76
7965G	15.40W (Class 3)	12.00	6.53	9.31
7970G	15.40W (Class 3)	10.25	6.28	8.11
7971G-GE	15.40W (Class 3)	14.90	9.17	12.28
7975G	15.40W (Class 3)	12.00	5.32	8.30

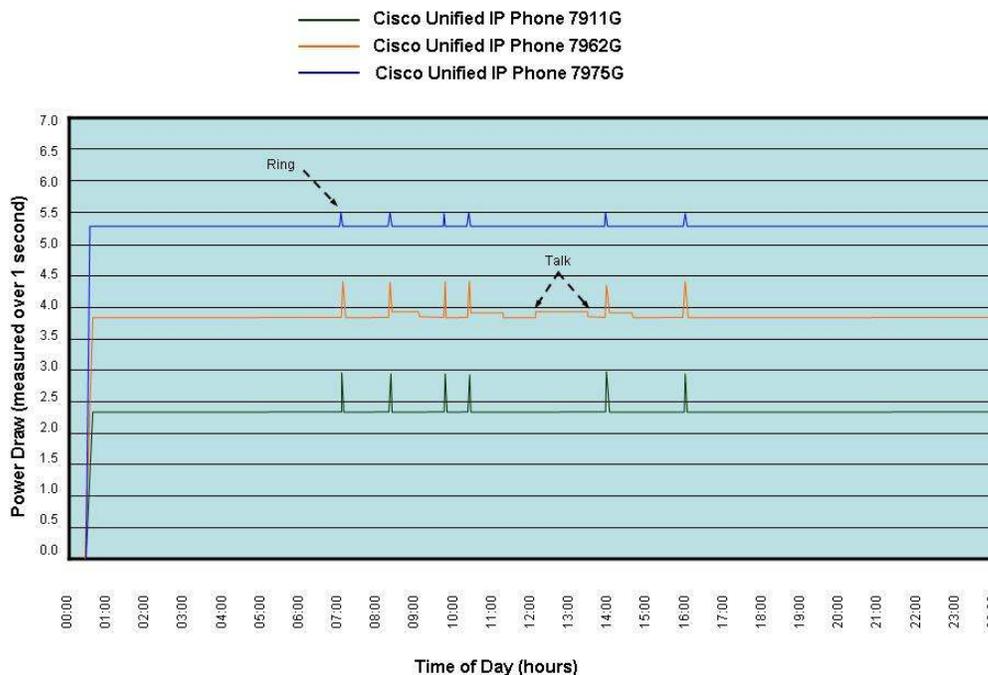
Real-Life Deployments and Cisco IP Phone Power Usage

Precisely how much power a Cisco Unified IP Phone consumes depends on both the phone model and individual user settings. Phone model and features and user preferences that can increase power consumption on a Cisco Unified IP Phone include the following: screen type (color versus grayscale), Gigabit Ethernet line speed, ringer and speakerphone volume, and illuminated keys (such as Message Waiting light and line buttons).

The amount of power that a Cisco Unified IP Phone uses daily is reflected predominantly in the idle power usage of the phone. Although ringing temporarily increases power usage, it does not statistically affect the overall power consumption of the phone over the course of the day. A few of the Cisco Unified IP Phones experience a slight power usage increase during an active call, but the active call and ringing events add less than 1 percent to the idle power usage, minimally affecting any calculations of daily power usage for the phone.

Although users configure and interact with their phones differently, the overall power usage during the day remains relatively flat. Even with the usage patterns in Figure 2, the total power draw, including ringing and talk time, has less than a 1-percent deviation from idle. This daily usage calculation assumes six incoming calls and talk time of 3.5 hours. If calculating the power consumption based on the 802.3af standard, then a Cisco Unified IP Phone 7975G consumes 370 watt-hours per day. If calculating the power consumption based on the Cisco Discovery Protocol power allocation, then that same Cisco Unified IP Phone 7975G consumes 288 watt-hours per day. But looking at the empirical power consumption in this example, a Cisco Unified IP Phone 7975G consumes only 127 watt-hours during the day.

Figure 2. Actual Cisco IP Phone Power Usage



Power over Ethernet in the Future

With phone users requiring additional connectivity from their communications device, in the future IP phones will probably ship with universal-serial-bus (USB) and Bluetooth capability. Interestingly, some of these new connection options will actually increase power requirements of these Ethernet-powered devices. But because those add-on devices may not be needed all the time, a mechanism is needed to dynamically adjust the power budget at the switch. The IEEE is working on a new PoE standard that will allow an Ethernet-powered device to dynamically adjust its power requirement. Currently, the IEEE 802.3at Task Force is working on defining this standard, which increases the power drawn by a device up to 30W and includes the ability for a device to dynamically negotiate power after the initial detection.

But the arrival of the 802.3at standard is still a few years away, and most PoE manufacturers and customers are looking for a more immediate solution to power budgeting.

One way to accomplish power savings is to use a management application to deny power to a connected Ethernet port. In environments where there is no phone use for extended periods of time (for example, from 8 p.m. until 7 a.m. and weekends), the use of Cisco switches and the Cisco IOS® Embedded Event Management (EEM) system will allow ports to deny power to Cisco Unified IP Phones (the use of EEM to deny power will render IP phones unusable). The EEM scripts are activated at a predefined time, typically after all users have left for the day. At that point the script is executed, and it identifies all inline-powered line cards and shuts down inline power for all ports on that module. Similarly, at a later predefined time, typically before users return to the office, the script reactivates inline power for all of those ports. This script is designed to offer those sites that do not have 24-hour high-availability requirements a means to conserve power during those times when use of inline powered devices is not required. The use of the script in this manner can lead to significant power savings.

The other method for reducing power consumption is to have the device enter a sleep or deep-sleep mode. The 802.3af specification requires the device to draw a minimum amount of power to keep the connection active. So if a device has been idle for a certain period of time, the device may enter a sleep mode and reduce power consumption to a minimal level to merely keep the network interface active while still providing complete services as needed by the user. However, this solution also would be practical only if the IP phone had “instant-on” capability so it could be used within 250 milliseconds of being awakened from the sleep mode. This example of network-based intelligence being used to facilitate changes in switch sleep modes and control networkwide IP phone state exemplifies the benefits of a Cisco on Cisco solution where Cisco Unified Communications interacts with Cisco infrastructure.

Summary

As corporations start looking at reducing power in their enterprise, Cisco Unified Communications Solutions, including Cisco Unified IP Phones, are an optimal choice for this environmental and business transformation. As a participating member of the IEEE 802.3af and 802.3at Task Forces, Cisco has been helping define the power negotiation standard for the PoE industry. At the same time, Cisco is working on reducing the power usage of its best-in-class IP phones. The newer versions in the Cisco Unified IP Phone portfolio include devices that offer more features while reducing overall power consumption by 41 percent (when comparing a Cisco Unified IP Phone 7971G-GE to the Cisco Unified IP Phone 7975G factory default power-consumption values).

One important point to consider when comparing environmental friendliness of unified communications solutions and IP phones is that the published numbers for Cisco Discovery Protocol are very conservative and intended to represent the maximum possible power draw with an added buffer to prevent overcurrent that may shut the power on the port off. Other factors including line loss have also already been calculated into the Cisco Discovery Protocol value.

Cisco Unified IP Phones are part of a network-centric unified communications architecture that is open, inclusive, and extensible. Cisco Unified Communications Solutions enable collaboration every time, everywhere, and with everyone included.

Additional References

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