



Power Considerations for VoIP

Protecting critical voice communications in the converged enterprise network environment

By Brad Amano Business Development Manager, Eaton Power Quality Solutions Operation

Abstract

Voice over Internet Protocol (VoIP) streamlines business network infrastructures, because one network does the work of two. The Ethernet LAN supports both voice and data. Another advantage is that VoIP phones can be powered right over the Ethernet communication line. There is no need for a separate wall outlet and wiring to power users' phones.

Power over Ethernet (PoE) has redefined the way organizations think about powering network components, but it requires data center managers and facilities managers to reconsider the way power protection is extended to VoIP devices.

The right uninterruptible power system (UPS) for a VoIP infrastructure will be governed by many factors that determine the right topology, power rating, battery runtime, form factor and remote UPS management.

These factors change dramatically with the adoption of PoE. For example, a communication closet with PoE capabilities consumes approximately four times as much power as one without PoE. This difference affects UPS sizing and battery runtime, which in turn, influence UPS footprint and installation options.

The good news is that centralized PoE power sourcing enables you to effectively provide centralized power protection—plus multi-layered power protection for added confidence. Power protection and distribution technologies are readily available today to ensure that VoIP networks are not vulnerable to the anomalies found in commercial utility power.

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Power Considerations for VoIP

Protecting critical voice communications in the converged enterprise network environment

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Voice over Internet Protocol (VoIP) has come a long way since the first rudimentary services enabled primitive, free calls over the open Internet. Times have changed. The maturity of VoIP standards and quality of service (QoS) on IP networks has made VoIP a compelling choice for business communications as well.

The market for hosted VoIP and managed IP PBX services reached \$24 billion in 2007, according to Infonetics research (*VoIP Services and Subscribers*, 2008). Growth in the strong double-digits is expected at least through 2010, according to the report.

To date, most of this growth has been fueled by residential and SOHO (small office, home office) subscribers—75 million of them in 2007, representing a 60 percent increase over 2006. Business growth is expected to accelerate as technology issues—most notably the availability and compatibility of Session Initiation Protocol (SIP) trunking services—are resolved.

However, as the IP network is pressed into service for yet another mission-critical application—a demanding one at that—it is time to revisit the way power is delivered and assured.

Why organizations should be looking seriously at VoIP

Converging voice and data onto the same network streamlines the architecture, optimizes bandwidth utilization, reduces costs and enables powerful new applications, such as call follow-me, unified communications and number portability—blending the many ways users communicate in a dynamic workplace.

VoIP has the potential to make business communications more powerful and productive than ever, even as business is conducted far outside the reach of the enterprise network—and even when the office is a hotel room today, a WiFi hot spot tomorrow and a home office the next day.

In addition to its benefits for productivity and convenience, VoIP offers a compelling business case. Converging voice and data on one IP network means fewer network elements, a streamlined architecture, only one network to manage, and only one service provider relationship to manage.

If used with SIP trunking to extend VoIP outside the company's walls, VoIP uses T1 bandwidth more efficiently, reduces long-distance termination charges, and reduces the cost of T1 trunks to the service provider.

For all these reasons, VoIP is gaining acceptance for business communications.





The power of Power over Ethernet

One of the beauties of VoIP is that one network can now do the work of two. The high-speed Ethernet local area network (LAN) supports both voice and data applications on one easily managed infrastructure. Another advantage is that VoIP phones can be powered right over the Ethernet communication line. There is no need for a separate wall outlet and wiring to power users' phones.

Power over Ethernet (PoE)—IEE standard 802.3af—integrates data, voice *and power* over a standard LAN infrastructure. It provides the means to supply reliable, continuous power to IP phones, wireless LAN access points, network cameras and other collaborative Ethernet devices using existing Cat5/5e or Cat6 cabling (see Figure 1).

The power can come from either midspan or end-span power source equipment. The midspan power hub is much like a patch panel, residing between the Ethernet switch or shared media device and the terminals (phones, security cameras, etc.). Power is added to the spare wires on a Cat-5/5e or 6 cable without disturbing the data on the same line. With an end-span power source, PoE is integrated into the switch and supplied directly from the data ports.





The LAN automatically sends power to compatible devices and blocks it from incompatible devices, thus protecting them and the infrastructure. That means users can freely and safely mix legacy and PoE-compatible devices on the network.

Power over Ethernet offers two obvious benefits:

- **Saves time and money**—there is no need to install separate power cabling, AC outlets, wall AC adapters and power protection devices for each phone to be powered.
- Streamlines power protection—you can manage power quality and availability at a central point, rather than at multiple desktops. One centralized UPS protects VoIP switches, gateways and the connected devices.





When voice service absolutely, positively must be on

When VoIP was viewed primarily as a way to avoid toll charges—relegated to personal and intracompany communications only—downtime was acceptable, even expected. Users knew there would be times when the network was down or congested. Email would be sluggish, and VoIP calls would be unavailable, sketchy or dropped. No problem. They could just pick up their regular desktop or cell phones and make the call.

That compromise will not work now. When an organization entrusts its entire voice communication environment to VoIP—including public interactions that define the company's image—the expectation is far different.

When used for premium voice applications, VoIP requires very high performance from the network in terms of latency, jitter and packet loss. Network equipment must perform up to specifications, and that means it must be running on continuous, clean power. End-user devices—such as IP phones, PCs equipped to perform as "softphones" and wireless access points—cannot be vulnerable to the hiccups and blips that hit commercial utility sites many times a day.

Fortunately, appropriate and cost-effective options are available to ensure the continuity and quality of power to VoIP systems.

If the VoIP infrastructure is powered from a PoE end-span...

The existing Ethernet switch is one that provides VoIP QoS, but it might not necessarily provide *standards-compliant* PoE capabilities. Without IEEE 802.3af PoE compliance, the switch will be incompatible with certain types of equipment. In this case, you can add an external PoE midspan device to power IP phones over the LAN. This strategy preserves the value of the existing infrastructure, reduces installation costs and enables support for legacy and IEEE 802.3af-standard devices. Wherever the power source point is located, it must be protected by an appropriate UPS.

If the VoIP infrastructure is powered from a PoE midspan...

It is a simple matter to provide the requisite power quality and availability. By connecting a UPS to a PoE midspan in the communication room, the entire IP telephony network is more reliable, running continuously during a power outage for as long as backup batteries hold out (see Figure 2). Reliability is further enhanced if the Ethernet switch or midspan power source is plugged into an outlet that is also protected by a centralized UPS at the site level.

Midspan PoE is becoming less common, since new installations and complete upgrades tend to use PoE-enabled switches, delivering power from the Ethernet switch itself. However, there are still applications for retrofitting existing applications with UPS protection, when there is no plan to replace legacy switches with PoE-enabled switches.

If the VoIP devices are powered from AC adapters at each location...

Consider two layers of protection against the possibility of losing phone service during a power outage. Even if the outlets are protected by a UPS at the site level, you will probably want small desktop UPSs to provide surge suppression and battery backup for each device. However, this is a cumbersome proposition, not to mention the extra wiring needed to each user's workspace. It is much more convenient and manageable to centralize VoIP/PoE power protection at the switch or midspan level.

Eaton[®] offers power protection solutions for all these scenarios. Whatever powering strategy the customer chooses, appropriate UPSs are available to greatly increase the reliability and availability of the VoIP application.







Figure 2. UPS protection for a VoIP infrastructure with midspan PoE

Selecting the optimum UPS for your VoIP application

The right UPS for a VoIP infrastructure will be governed by many factors that determine the selection of:

- **Topology**—standby, line-interactive or online
- **Power rating**—from <700VA and up
- Battery runtime—from 30 minutes to eight hours of runtime during power outages
- Form factor—desktop, rackmount or tower
- **Remote UPS management**—Simple Network Management Protocol (SNMP), Web and/or integrated with existing management systems

Let's take a high-level look at some of the key considerations.

Which UPS topology should you use?

The two most common UPS topologies are line-interactive and online. Line-interactive UPSs protect equipment and sensitive applications against the most common power quality problems at an attractive cost, but VoIP applications typically need an even higher level of protection.

To provide availability comparable to the traditional, circuit-switched phone system, a VoIP infrastructure should have the protection a online UPS offers, including:

- **Complete isolation from utility power aberrations**. Online UPSs use a rectifier and inverter to completely isolate equipment from utility power and deliver clean sine wave power. All transfers to and from battery backup mode are completely seamless. In the rare event of a problem with the UPS, an automatic bypass redirects the power path around internal UPS circuitry to continue to power loads.
- **Precise voltage regulation.** With line-interactive UPSs, output voltage fluctuates within a fairly large window. In contrast, online UPSs deliver steady and precise voltage even in extreme low-line conditions, without draining batteries.





• **Generator compatibility.** More and more organizations combine the power quality provided by a UPS with the unlimited backup time of a generator. When starting up, generators may generate frequency fluctuations that some UPSs will not tolerate. Online UPSs are designed for full generator compatibility.

The economical standby topology is suitable for only the smallest UPSs, those that would be deployed at users' desks if their PC, IP phone and other desktop electronics were not protected by a centralized UPS.

UPS rating—how to size the PoE midspan power source and its UPS

The level of power typically consumed in a communication room with PoE capabilities is approximately four times that consumed by networks without PoE. For example, a typical 24-port Ethernet switch consumes an average of 100W, whereas an Ethernet switch powering 24 IP phones requires about 400W.

More specifically, the PoE standard specifies up to 15W per attached device. Typical PoEcompatible devices actually consume somewhat less than that: 5W for IP phones, 6–10W for wireless access points, and 9–12W for IP cameras.

Let's look at a hypothetical (but typical) communication room. In our sample configuration, eight stackable Ethernet switches are installed, providing service to 192 users. In line with best practices for Ethernet switch installations, 25 to 30 percent of the midspan ports are left unused for future growth. Therefore, six spare ports in a 24-port midspan are left unused.

If these switches were *not* powering PoE devices, a UPS rated for 1500W would be sufficient. However, to support a converged voice environment with PoE, the UPS backup systems should be rated for 6000W.

Exactly how much power is being consumed in a PoE environment? In addition to the switches and midspan PoE power source units, you need to be able to track the power consumed by all those IP phones and other PoE devices. A midspan PoE device that supports SNMP will be able to provide this figure to aid in appropriately sizing the UPS.

The first worksheet shown is used to generate a quick estimate of UPS rating requirements, accounting for future growth.

Equipment	Rated input power in watts	X	Number of stacked switches	X	1/power factor	=	Power in VA
24-port switches without PoE support		Х		Х		=	
24-port switches with PoE support		Х		Х		=	
Midspan units		Х		Х		=	
Other equipment		Х		Х		=	
					Extra power margin for future expansion	=	х %
				- 1	Total UPS sizing	=	

This worksheet provides an estimate of UPS rating requirements.

The second worksheet shows an example for a switching closet with 96 IP lines (4x24-port switches) providing connectivity to 48 users, each with a PC and a PoE-powered IP phone.



Equipment	Rated input power in watts	X	Number of stacked switches	>	1/power factor	-	Power in VA
24-port switches without PoE support	150	Х		4 X	1.10	=	660
24-port switches with PoE support	400	Х		0 >	1.10	=	0
Midspan units	220	Х		2 >	1.05	=	462
Other equipment	0	Х		0 >	1.43	=	0
					Extra power margin for future expansion	=	40%
					Total UPS sizing	=	1570

This worksheet shows an example for a switching closet with 96 IP lines.

In this environment, a single-phase UPS with a power rating of 2200 VA is optimal—assuming that switches and phones are power-protected at the switch closet level. (In some companies, the entire building is also equipped with a large, centralized outlet that protects all outlets in the site.) However, a UPS larger than 2200 VA might be necessary just to get the needed battery runtime.

UPS battery runtime

How much battery runtime will you need to power IP phones during an outage? A common goal for VoIP networks is to consistently achieve five nines (99.999 percent) availability, with 5.3 minutes or less of downtime per year. To achieve that level of uptime, an organization will need a UPS with anywhere from 30 minutes to eight hours of battery runtime.

UPS internal batteries typically run loads for five to 10 minutes, sometimes longer—long enough to gracefully shut down systems during an outage. To achieve the longer runtimes required by VoIP applications, the UPS will need external battery modules (EBMs). Modern UPSs use rackmounted battery modules that occupy only 2U or 3U. You can usually add one to four EBMs to provision the runtime you need.

What UPS form factor is best for your situation?

The selection of form factor is a matter of personal choice, depending on the space available in equipment racks and where the UPS will be deployed. For example:

- Space-saving, high-density rackmounted UPSs can be installed in the same rack as IT equipment—ideal for rack environments containing PoE switches and midspan equipment.
- Elegant tower units fit under a desk or in an office or equipment closet for locations where IT rack space is at a premium.
- Economical standby UPSs about the size of a shoebox make distributed UPS protection with battery backup affordable for desktops where individual IP phones are powered by wall outlets.

Wiring/edge closets were typically not designed to accommodate a lot of equipment, so most organizations prefer UPSs that integrate easily into existing 19-inch racks.





Remote UPS management capabilities

Since UPS equipment will probably be out of sight in switch closets—or distributed around the facility—look for UPS systems that can be managed remotely over the network. Various options are available to communicate with the UPS and midspan PoE units:

- Industry-standard SNMP communications
- XML (Extensible Markup Language) using a standard Web browser
- An existing network management system (NMS)

Network communications enable some essential features for monitoring and managing the VoIP infrastructure and its power protection systems. For example, when the **PoE midspan unit** is SNMP-capable, it can:

- Integrate with power systems supervision software for autodiscovery of midspan units in the network, alert reporting and more.
- Deliver telemetry of IP phone status and presence and send alerts about a change in IP phone status (such as fall in power consumption, disappearance or malfunction).
- Send information about power consumption, which is especially helpful for monitoring power utilization and sizing UPSs for the network.
- Power-off IP phones when not in use, such as weekends and holidays, to save money and prevent unauthorized use of the phones.
- Selectively power-off non-critical devices during a power outage to extend valuable battery runtime for only the most critical phones, security cameras or other PoE powered devices.

When the UPS is XML- and SNMP-capable, authorized administrators can:

- Monitor UPS parameters such as battery levels, power quality, UPS state, alerts and more, using a standard Web browser or an SNMP-compatible management system.
- Receive automatic event notifications and program automatic actions in the event of low battery conditions, system shutdowns, etc.
- Discover, map and manage the UPS via standard platforms, such as HP Openview, IBM Tivoli or Computer Associates Unicenter.

For VoIP environments, choose a UPS that interfaces with the enterprise standards, offers remote administration, can act upon events automatically and integrate easily with the NMS platform. In all cases, look for seamless integration of a network interface in the UPS and availability of the adequate interface software components.





Power protection for other PoE applications

VoIP is not the only edge application that requires high availability. Wireless LANs and security devices can also benefit from PoE and centralized UPS protection.

- Wireless LANs can use PoE to dramatically simplify cabling, eliminating the low-voltage DC power cable to each access point. In many cases, wireless LANs are mission-critical and should have power protection from a centralized UPS in the switch closet.
- IP-based security devices (network cameras, access control devices, etc.) tend to be powered through PoE over the LAN. Since their function is essential, these devices must continue to operate during a power outage. A centralized UPS with long battery runtime is an absolute requirement.

Users have very high uptime expectations for VoIP networks. Modern UPS systems provide affordable and reliable insurance against the high cost of potentially losing business communications, even briefly.

Conclusion

Power over Ethernet has redefined the way organizations think about powering network components, such as IP phones, wireless access points and IP-based security devices. At the same time, PoE should cause data center managers and facilities managers to reconsider the way power protection is extended to these devices.

The good news is that centralized PoE power sourcing enables you to effectively provide centralized power protection—plus multi-layered power protection for added confidence. Power protection and distribution technologies are readily available today to ensure that VoIP networks are not subject to the inconsistencies and anomalies found in commercial utility power.

About Eaton

Eaton Corporation is a diversified power management company with 2007 sales of \$13 billion. Eaton is a global technology leader in electrical systems for power quality, distribution and control; hydraulics components, systems and services for industrial and mobile equipment; aerospace fuel, hydraulics and pneumatic systems for commercial and military use; and truck and automotive drivetrain and powertrain systems for performance, fuel economy and safety. Eaton has approximately 75,000 employees and sells products to customers in more than 150 countries. For more information, visit <u>www.eaton.com</u>.

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