Power Protection—Pay A Little Now, Or A Lot Later

Matt Brunk

If your voice and data are running on one network, you'd better make sure the juice keeps flowing—properly.

Last year's major blackout in the eastern U.S. demonstrated the critical role that power plays in our businesses—including our communications networks. Not long afterwards, while I was preparing this article, a hurricane hit our area and it hit hard, stranding homeowners and businesses for days.

Personally speaking, there are two things I've got to have to survive—a shower and coffee. After three days of no shower and stalking the local 7-11 for fresh coffee, my attitude towards spending significantly more on uptime has changed. As voice and data systems converge on a single network, and potentially even a single cable plant, power protection becomes more crucial than ever.

As a manager of other companies' telephony systems, I am not open to negotiation when it comes to *what* gets installed to electrically protect the systems. The only exceptions I'll make is if the customer wants extra protection *beyond* the line items in the proposal—for example, more run time on the uninterruptible power supply (UPS) or some added features, specific protection objectives or functionality.

Some may think this policy is too rigid and is intended to put more money in our pocket, but the opposite is true. Sites with solid power protection are proven to have less service and repair work, year after year. For me, that translates to a significant decrease in truck rolls. And since protected systems last longer, there are fewer opportunities to sell replacement systems prematurely.

Our philosophy is simple: If the customer keeps seeing us onsite, then the purchase must not have been a good one, or why else do we keep showing up to fix things? As a service company, we cannot afford to not protect our customers' systems.

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Uninterruptible Power Supply

All telephony systems are subject to power disturbances and disruptions, since they are powered networks. Organizations must recognize the need to maintain their powered networks, especially when it comes to IP-telephony and IP-PBXs running on converged cable and networks.

An IP-PBX needs an uninterruptible power supply (UPS), sized according to your equipment's power consumption and how much uptime you need (based upon site experience and dictated by your "known" losses). Whatever touches the IP-PBX must connect to your UPS, so for example, if you are running a server solution for your call center, connect it to the UPS and include it in your initial power equation when sizing the UPS. Remote closets housing switches, power over Ethernet (PoE) and other LAN equipment also need their own UPSs.

Generally speaking, we size UPSs for the site and for interruptions in power up to one hour. Some sites, depending upon the requirements of the customer or the overall quality of power, dictate different run times.

Longer battery times can also be provided by using emergency generators, which are more expensive, and their limitation is usually the supply of fuel. *A caution about emergency generators*: They must be configured to provide steady power (line output), otherwise when they first turn on, expect a nasty surge that may defeat why you bought the generator.

At my own offices, I have added an emergency LP (liquefied petroleum gas)/natural gas generator from Onan—a $15,000 line item—in the 2004 budget. On top of the basic cost, with most generators an automatic transfer switch is wired into the panel, at an additional $1,200.

We did this because we needed to beef up our own power protection after reconfiguring the elements supported on my office network: Alarm system, IP-PBX, firewall, router, LAN switches, PoE, SAN file server, music-on-hold and the many products plugged in for our lab testing. Under the old configuration, our existing UPS—an APC Matrix XR—could support a runtime of a

little more than three days. After the reconfiguration, our runtime is down to about four hours, because the UPS now has to support more equipment for our new customer network monitoring service, which along with other new gear puts a greater power demand on the UPS.

Here's another example—a customer voice over IP (VOIP) deployment: We have installed LAN switches with PoE in a building connected via underground fiber to another building on the same campus that houses LAN switches with PoE, then connected to a third building housing the IP-PBX, LAN switches, PoE, router, CSU and channel banks and maintenance equipment. All three buildings also have underground direct-buried 50-pair cable to provide analog lines and backup dialtone in the event the IP-PBX is down.

We have UPSs deployed at both the main building and the two remote buildings. In more than two years of operation, this site has experienced only two prolonged blackouts that exceeded the UPS runtime.

Purchasing UPS

Manufacturers such as APC, Oneac, Liebert, Powerware and TrippLite offer a range of UPS products for small business to large enterprise, including assistance to size your UPS appropriately. Not all UPSs are equal, so examine the products in detail to match them to your needs.

Some key things to consider in selecting a UPS manufacturer for an IP-PBX:

1.) Does the UPS provide filtered power (line-out)? UPSs that provide "conditioned" or "filtered" power use isolation transformers to provide clean power from the UPS to the equipment. Conditioned power guards against electro-static discharge (ESD) and low-energy interference. This is not a standard feature in UPSs.

2.) Does the UPS allow "let-through" voltage? Let-through is the amount of voltage "let-through" to your equipment. *More is not good, less is better, and none is best.*

3.) Is the UPS manageable, and can it automatically shut down the IP-PBX when the batteries are too low (via a serial or LAN interface)?

Another note about UPSs: Batteries last 2–5 years, depending upon the quality of power at your sites. The batteries must be replaced at some point. You must also consider, when sizing your UPS, that each UPS configuration will require time to recharge batteries. So if you need one hour of runtime, you may want to provide for runtime beyond one hour—which means purchasing a larger unit or more batteries.

We use a few methods to test and monitor batteries: APC's PowerChute, Qovia's Ion and other tools show the line input, power utilization, and battery level of the UPS. We also use a hand-held tester from Tasco—a great little tool that not only tests the output voltage of the UPS but can be left behind on a customer site and plugged into a suspect area taking power hits. We also test the UPS using the Tasco whenever we're on site doing service or moves-adds-changes (MACs), since we're there anyway and it takes less than a minute.

Whole-Panel Protection

UPS, with the potential addition of an emergency generator, can help keep your systems running during a commercial power failure. The other major issue in power is making sure that power spikes or surges don't damage your networking equipment. This breaks down into two categories: Whole-panel protection and low voltage (LV) circuit protection.

But before we discuss protection methods, we need to mention grounding, be it of the AC service, telecommunications circuits, cabling or racks and hardware. Grounding is an essential element to any protective and conditioning equipment. Without proper grounding, even the best protection equipment offers little protection. Each state and even county government will have its electrical code requirements for grounding.

Whole-panel protection guards against transient voltages and surges caused by lightning, utility company switching and electrostatic discharge. Whole-panel protectors are installed on service panels and protect from high voltages, but do not eliminate the need for low-voltage protection.

For our offices, we decided to replace our 10-year-old whole-panel protection system after the hurricane. We'd been having trouble related to whole-panel protection. We had to replace incandescent and fluorescent bulbs every 5–7 weeks and one 250-volt/30-amp fuse for the hot water heater. We also shelled out about $700 for a fried motherboard on the one-year-old HVAC system, and another $60 for a burned out fluorescent fixture. Fortunately, nothing on our LAN or IP infrastructure, including any workstations, suffered any electrical damage.

We went with a new unit from Citel that meets the relevant electrical standards—UL1449 2nd edition and ANSI/IEEE C62.41. The folks at Citel were exceptionally helpful in reviewing our configuration, history and needs to minimize power disturbances and influences. Next, our electrician reviewed the specifications from Citel and agreed that our reconfiguration was in order. My office building is only about 900 square feet total, with 200-amp service, so whole-site protection was less than $600 using the Citel high energy surge suppressor service entrance protector P/N CDS250VG/DF.

For larger enterprises, the added costs of protecting your buildings are justified since you can deter power issues from harming not just the telecommunications gear, but anything electrically-powered on your site, minimizing disruption to business. For example, what good is it to have a UPS running on a generator if the HVAC system fails due to electrical damage?

Power protection benefits not only your telecom gear, but everything electrical on site

Everyday sources of static charges could be enough to knock down an IP-PBX

This disruption can be costly. According to the National Lightning Safety Institute, lightning losses alone may reach $4 billion–$5 billion per year, when you include downtime, loss of potential revenue, etc. Whole panel or whole house/building protection makes sense not only for the user but for anyone paying monthly insurance premiums.

(For more information, Cuttler-Hammer has published several online examples of enterprises that adopted a "facility wide" power protection plan: www.cutler-hammer.eaton.com/unsecure/html/101basics/Module28/Output/Lightning.html.)

Obviously, I can't convince all my customers to purchase whole-panel protection, since many of them rent their buildings, office space and warehouses. Some make the investment anyway, since they know the value from first-hand experience with blown utility transformers, lightning hits and the never-ending electrical surges hitting power and communications circuits.

Circuit Protection

Now that we've spent most of your money on batteries and whole-panel protection, we just need to spend a little more and in the right places to ensure that the IP-PBX doesn't go ballistic when a spike traverses the LAN—and it will—thus causing it to go bump and even hard down.

You must first envision *all* the connections on your converged network. Every device that is locally powered could potentially fail to isolate and contain the effects of a power hit, allowing the spike to enter the converged network, creating havoc. You may have heard that it's not the voltage that kills people but the amperage. The opposite is true for your converged network.

Rub your feet across the office carpet on a cold wintry day to build up a static charge and those *volts* can easily knock down your IP-PBX. It could be a waxed tile floor that is exposed to sunlight out in sunny San Diego, with a technician walking across that floor and then touching a cabinet. Or it could be a secretary or call center operator rolling their chairs across the plastic chair mats during the winter months.

My favorite find is about an historic inn in western Maryland. Each day, after the maids made up the rooms, the facilities manager would get a call stating that the same set of telephones serving the just made-up rooms would fail. Later, by chance, the facilities manager was in a guest room while the maids were making up a room. As they fluffed the bed sheets, they would come in contact with the telephone on the night stand next to the bed. The maids complained about the telephone "shocking" them. In fact, they were shocking the telephone.

Dry air, forced heated air dropped from the ceiling, and maids making up beds: Power influences originate not just from the utility company, but from internal sources too. All telephony systems are influenced, not just IP-PBXs—though systems react differently to the various types of power influences. These cases are real-life personal experiences that took a lot of time to diagnose, and even more time to isolate.

Protecting Outside Circuits

It's not just your converged LAN that you have to worry about. Every central office (CO) line, trunk or circuit must be protected.

For example, in the three-building site discussed in the earlier section on UPS, we have also protected the 50-pair cable on *all* ends using Porta Systems Model 581 protectors designed for higher voltages. In addition to the Porta Systems we have ITW/Linx TowerMax products installed for analog (2500), CO and other circuits needing low voltage protection. The Porta Systems protectors are the "primary" protection; between the circuits (demarcation to IP-PBX) we also have secondary protection, which will clamp smaller yet unacceptable voltages.

Sometimes overlooked is proper protection of the CSU—plug in the protection before the CSU, not after. Then, connect the CSU to the output side of the protector.

Telecommunications circuit protection manufacturers include Citel, Ditek, ITW/Linx, Oneac and Porta Systems.

Protecting your telecommunications circuits connected to the IP-PBX and other networking hardware will help minimize downtime and the revolving door of replacement parts. The most typical occurrence is the loss of IP telephones that have computers plugged into them. These telephones simply will not last as long on an unprotected, converged cable plant.

It is a good practice to ground equipment racks, cabinets and housings. Paging, door and call box and special circuits also need protection before connecting to the IP-PBX. Next, the IP-PBX connection to the LAN needs protection from the LAN side. I've used several of the ITW/Linx products such as the M8COM-60, GTM 6010 LAN UTP and the Allpath surge strip, and GTM 1500 MaxLan gigabit module. *None* of my IP-PBX sites has its connection to the LAN unprotected—that is inviting certain disaster and unrelenting ailments that play hide and seek.

If you're properly prepared, the worst that can happen to your IP-PBX when the protection equipment takes a hit—i.e., as little as 16 or more volts DC beyond the operating range—is that service goes down until the protection equipment releases or resets, which is normally very fast. This added and very small cost is far better than not having the protection and allowing that same voltage to hit the IP-PBX, knocking out its processor, corrupting the hard drive and leaving an anxious customer waiting for you to show up onsite, hoping you will know how to quickly resolve the problem(s).

A problem I've found on many sites is that the telecommunications circuits coming into the suite or building have high-voltage protection on the entrance, but fail to protect the lower voltage window of the circuits' or equipments' acceptable power operating range. If those same cable pairs are used for off-premise digital or telecommuter stations, then they must also include the lower-voltage protection within their operating range.

Another issue is powering IP telephone sets with local power instead of power over Ethernet. PoE adds to the cost of the IP-PBX but, long term, it will remove the headaches associated with power and troubleshooting, which can become complex very quickly. The PoE hardware must also be on UPS.

After four-plus years of installing IP phones, I saved almost every power brick that shipped with the phones and sold many of them on eBay, in lots of six, since the manufacturer wouldn't stop shipping the 2.1 pounds of transformer (power brick). The only good purpose for the local power bricks is to have some on hand for when the PoE hardware blows out.

One Cable, Many Headaches

There's one more threat to worry about: The faith that users and VARs put in the one-cable concept for the telephone and the workstation. I've deployed it too, but only with the proper protection in place and when necessary to meet the customer's requirements, which are usually cost-related or a limitation on re-cabling.

When using one cable, the protection needs to be done at the terminating end in the wire closet, intermediate distribution frame, (IDF) and/or main distribution frame (MDF) before the drop patches into the supporting LAN switch. For 10-Mbps networks, we used the Panamax Power-MAX LAN UTP P/N GRM-7850. The GRM-7850 is rack-mounted and protects 12 drops patching in from the patch panel and then connecting the "out" to the LAN switch port.

We used this equipment on three problem IP-PBX sites, each of which used only one cable drop to share the IP telephone and PC. The first site is a dictation company processing hundreds of hours of medical transcription each week. One site is a coffee company with a coffee roasting plant housed next to the offices; and the third site is a machine metal and roof fabrication shop.

During the first six weeks of installation, all sites lost hard drives, call processors, IP telephones and suffered corrupted databases. The dictation company is in a building that suffers from power overload—the demand is too great for what it was originally wired for, and the building just has poor power. The coffee company's roasting machine is the culprit in creating countless hours of troubleshooting and repeated service calls, since each morning as the machine was powered on, it would throw out noise to every circuit on the panel (there was no isolation transformer between the plant and offices). The machine metal and roof fabrication shop has a press that throws out power spikes and noise throughout the day, and resides in the same building housing the offices.

Thanks to the power protection devices, all sites have run trouble-free (other than minor CO issues, handset replacements, software upgrades) since December 2000. However, the device we used, the ITW/Linx GRM-7850, doesn't support 100-Mbps, and the vendor has discontinued it and replaced it with a new product, the DataLinx, available in two models, one for LAN (P/N DL1200) and for LANs with PoE (P/N DL1200-POE).

Anyone who wants to adopt a single cable plant to run IP phones and computers should consider replacing every patch panel with the ITW/Linx DataLinx equipment. Never consider running a converged network without adequate protection and the adoption of PoE. This is another very distinctive difference between traditional telephony systems and IP-PBXs.

One major mistake that we made was using a protector that allowed "let-through voltage." Let-through voltage also crippled another site using converged wiring and a 10-Mbps LAN. The Ethernet protectors only failed marginally, so after the first power hit, the IP-PBX remained on-line until the next power hit, which followed only minutes later.

With this second event, the secondary Ethernet protectors allowed "let-through voltage" escape and basically killed the IP-PBX, LAN switch, PoE, telephones and computers. Unlike the protectors that worked perfectly within a high voltage range, the low-voltage protectors failed miserably, in that they did not properly fail completely and they allowed enough let-through voltage to kill the connected equipment.

That night we worked for free. We replaced the units with the ITW/Linx TowerMax LAN-UTP modules. That was in June, 2000, and this site has run basically trouble free since then.

Conclusion

I'd like to mention a few cautionary notes about this entire article:

- First and foremost, if you don't know what you're doing, stay out of the kitchen and hire an electrician, or other talent as required. Even the folks you pay make honest mistakes, as we have. We have a terrific electrician and he's an invaluable resource.
- For the large UPS users, if you ever detect a "rotten egg"-like smell, get the equipment shut down ASAP, then turn off the UPS and ensure that personnel are distanced from the UPS until it cools down, and the batteries' swelling goes down. This takes time—hours.

The smell means the batteries and/or UPS have an issue. Immediately call the UPS manufacturer's

When in doubt, find a good electrician

Don't get complacent about power protection

tech support. We also have posted in the kitchen (not next to the unit) emergency clean-up procedures in the unlikely event the batteries explode.

- Never plug any UPS into another UPS.
- Tag all ground connections "DO NOT REMOVE."
- When you order products that have fuses, *always* order plenty of extra fuses for the site(s) and leave them onsite in a secure place. Immediately discard bad or suspect fuses.
- Don't get complacent; things change.
- Never use any protection equipment that allows "let-through voltage" that is next in-line to your equipment you want protected.
- If the IP-PBX backplane doesn't tolerate power-induced noise, then you must ground the chassis, or frame/rack to which it's attached.
- Always consult with the National Electric Code (NEC); also visit the National Fire Protection Agency website (www.nfpa.org)
- The manufacturers mentioned in this article are not comprehensive; there are others.
- Manufacturers of telecom and data gear may have "built-in protection," but I advise you strongly to use other primary and secondary protectors installed before their gear. This strategy has proven effective for me over the years.
- Always consider purchasing the service contract on generators.
- Whole-panel protectors are *not* a cure-all. You must establish your goals and aim to minimize your losses and "risk of loss."
- Learn from the mistakes of others.
- Read the fine print in the warranty.
- Make friends with a good electrician□

Companies Mentioned In This Article

Allegheny Power Company (www.alleghenypower.com)

APC (www.apcc.com)

Citel (www.citelprotection.com)

Cutler-Hammer (www.cutler-hammer.com)

Ditek (www.ditekcorp.com

ITW/Linx (www.itwlinx.com)

Liebert (www.liebert.com)

National Lightning Safety Institute (www.lightningsafety.com/nlsi_lls/nlsi_annual_usa_losses.htm)

Oneac (www.oneac.com)

Onan (www.onan.com)

Porta Systems (www.portasystems.com)

Powerware (www.powerware.com/countries/usa_new/index.asp)

Tasco (www.tasco-usa.com/acmon.htm)

TrippLite (www.tripplite.com)