WHITE PAPER

3 Steps to Ensure Reliable Power, 911 Service and Dial Tone Availability for VoIP and Internet Telephony Applications

Executive Summary

When transitioning from a traditional phone network to a voice over IP (VoIP) network, it is essential to recognize a key difference between the public switched telephone network (PSTN) and the private data network that will be called upon to take its place. The PSTN is connected to a massive battery array that allows it to provide emergency 911 service and dial tone availability for up to eight hours during an extended power outage. Although most private data networks incorporate some form of backup power, runtime is typically provisioned to prevent network service interruptions during brief power problems and outages that last seconds or minutes, not extended outages that last hours. In order to provide the high level of emergency 911 service and dial tone availability established by the PSTN, you need to address this difference when designing your VoIP network:

1. Recognize the need to integrate long-lasting backup power into VoIP networks
2. Consider the diverse power requirements of VoIP network equipment
3. Choose UPS systems that provide high availability, resilience and manageability

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Recognize the Need to Integrate Long-Lasting Backup Power into VoIP Networks

VoIP has exploded in popularity as an application for data networks. VoIP consolidates a company's data and telecommunications infrastructure, as well as its support resources. As a result, a company can lower its hardware and service costs while raising productivity through the use of more elaborate and customizable IP telephony applications.

Unfortunately, there are serious limitations inherent to the data networks that are called upon to support VoIP. The primary limitation is power availability. Before moving voice traffic from traditional circuit-switched public phone systems to private data network connections, one must consider a public phone system's unique attribute: battery support. In order to deliver extremely high availability for such vital services as emergency 911 support in the event of extended power outages, public phone systems are connected to massive battery arrays.

In order to reach the high level of dial tone and emergency 911 service availability established by the traditional public switched telephone network, the design of your VoIP network must incorporate long-lasting backup power.

While most data networks have some type of backup support during power outages (provided by UPS systems and/or generators), the backup runtime is generally much less than the 4 to 8 hours of backup that is typically provided for public phone systems. Because of this shortcoming, VoIP applications generally require an increase in the UPS system-supported power capacity (i.e. more or larger UPS systems). Increased UPS system capacity provides power for network-dependent phones and increases overall backup runtime to ensure that normal telephone operation (including 911 service) remains available in the event of an extended power outage.

Reflecting on important lessons learned during its own transition to VoIP telephony, Cisco provides several best-practice recommendations. One of the most important recommendations is installing a UPS system to guarantee 911 service and dial tone availability:

"Plan your power: When an IP network carries voice, reliability is essential. In case of an emergency, people need to summon assistance by dialing 911. When using in-line power to switches and routers, make sure they are connected to an uninterruptible power supply [UPS system] to guarantee dial tone if the power should go out."[1]

Consider the Diverse Power Requirements of VoIP Network Equipment

Before selecting UPS systems to support the availability of VoIP systems, it's important to consider the unique requirements of VoIP network equipment. Network designs hosting VoIP applications vary widely from business to business due to a number of variables, including the scale of the network and the variety of legacy equipment involved. However, three types of devices are common to all networks: client devices, network devices and call-processing devices.

If IP phones plug into an AC outlet at the desk, they will require UPS backup at the desk. If IP phones receive in-line power (Power over Ethernet or PoE) through the network cable, they will not require backup power at the desk. However, the PoE network switch will require higher-capacity and longer-lasting UPS backup than a non-PoE, non-VoIP network switch.

Client Devices (IP Phones, PC-Based Soft Phones, etc.)

During the transition to VoIP, these devices will either (a) derive their power from the network cable through a Power over Ethernet (PoE) connection scheme, or (b) plug into a local AC source.

If they plug into a local AC source, they must be protected by a UPS system. A desktop UPS system can serve a dual purpose by supporting the user's IP phone and ensuring VoIP service availability while simultaneously supporting the user's computer system.

Network Devices (Switches, Routers, etc.)

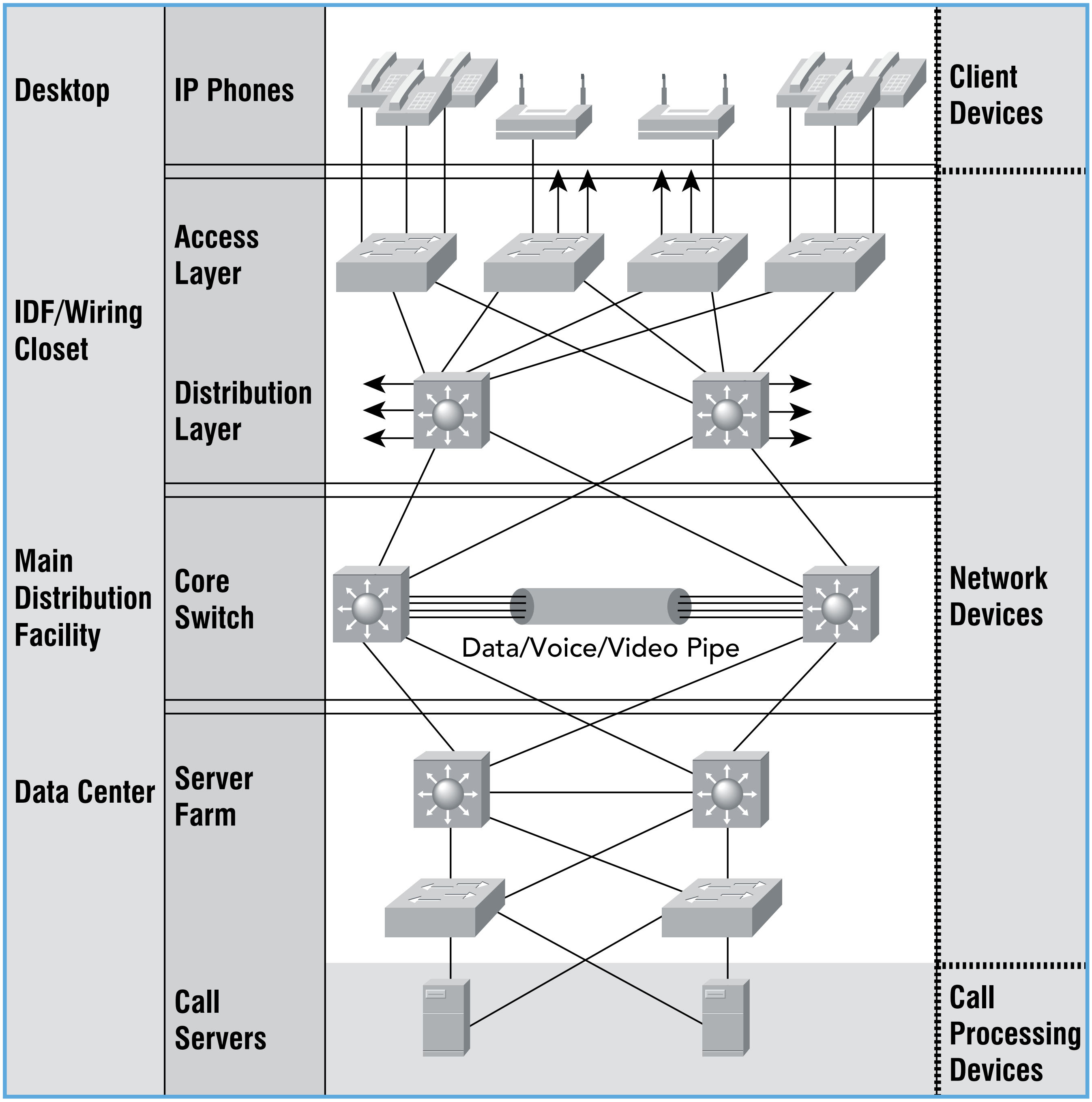
During the transition to VoIP, port capacity on the network and in wiring closets will increase to accommodate additional devices (IP phones) connected to the network. Increased port capacity will increase the power requirements placed on your UPS system, either reducing runtime or overloading the UPS. If a network device also supplies Power over Ethernet, the aggregate load of all client devices will also be borne by the networking device's UPS system.

Generally, an existing UPS will be inadequate both to power the increased load (watts) and to support the load for an acceptable length of time during an outage. Five to fifteen minutes of runtime provided to gracefully shut down the typical data network is inadequate for VoIP users who expect phone service to continue for hours, not minutes.

Call-Processing Devices (Servers and Related Storage)

During the transition to VoIP, dedicated servers are typically added to drive voice and messaging applications, while storage systems are required for voicemail and other messaging applications. Similar to the increased burden placed on networking devices, call-processing devices will experience increased loads and will require increased backup runtime.

Typical VoIP Network Design[2]



A typical VoIP network design includes several functional layers distributed throughout a facility or campus. Each layer includes different types of equipment, and each type of equipment has unique power requirements that you must consider when provisioning UPS systems for backup power.

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Choose UPS Systems that Provide High Availability, Resilience and Manageability

When selecting a UPS systems for VoIP applications, you obviously need to consider the VA/watt capacity and battery backup runtime requirements. You also need to consider subtler criteria that are nonetheless vital to the success of your VoIP network, including availability, resilience and manageability.

When choosing a UPS system, the most obvious criteria to consider are whether the UPS system has enough capacity (VA/watts) to power equipment and whether the UPS system has enough battery capacity to operate during a power outage for the required duration. Often overlooked during the selection process, however, are more subtle, yet critical, criteria that should be considered, including availability, resilience to power anomalies and manageability.

High Availability

Availability hinges on three considerations: the VoIP equipment's power supply configuration, the UPS system's battery configuration and the UPS system's power electronics topology.

VoIP Equipment Power Supply Configuration

Many switches and routers are equipped with redundant power supply capability. If one power supply fails, a second power supply instantly steps in and powers the device. Redundant power supply configurations are strongly recommended to ensure continuous system availability.

Whether one or two power supplies are deployed, the equipment can draw power from one of three sources: directly from facility power alone (for simplicity's sake we will use the term "wall" to describe this source), from a single UPS system or from multiple UPS systems.

The following tables detail a switch's operational status, from a power perspective, in both redundant and combined (non-redundant) modes. The tables detail switch status under a variety of operational scenarios, including power supply failure, utility failure and UPS system failure.

Note: Larger switches often have the capability to be alternatively configured to operate in a combined (non-redundant) configuration. In combined mode, two power supplies' capacities will be summed. A true doubling is not generally achieved; a factor of 1.67x is typical. In combined mode, there is no redundancy. Should a power supply fail, the available power is generally reduced to the capacity of a single power supply.

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Single Power Supply or Multiple Power Supplies Operating in Redundant Mode

STEP 1: Determine Configuration

Configuration	1	2		3		4	5	
Power Supply	PS1	PS1	PS2	PS1	PS2	PS1 & PS2	PS1	PS2
Power Source	Wall	Wall	Wall	UPS1	Wall	UPS1	UPS1	UPS2

STEP 2: Consider Failure Scenarios			**STEP 3: Consider System Status**				
PS1 Status	**Utility Status**	**UPS Status**	**System Status** (1)	**System Status** (2)	**System Status** (3)	**System Status** (4)	**System Status** (5)
OK	OK	OK	OK	OK	OK	OK	OK
Failure	OK	OK	Crash	OK	OK	Crash	OK
OK	Blackout	OK	Crash	Crash	OK	OK	OK
OK	Blackout	UPS1 Battery Fails	Crash	Crash	Crash	Crash	OK
OK	Blackout	UPS1 Internal Fault	Crash	Crash	Crash	Crash	OK
OK	OK	UPS1 Battery Fails	—	—	OK Hot-swap battery.	OK Hot-swap battery.	OK Hot-swap battery.
OK	OK	UPS1 Internal Fault	—	—	**Line-Interactive UPS Systems**		
					OK Replace UPS. System on PS2/Wall. Vulnerable to outage during UPS replacement.	Crash Replace UPS.	OK Replace UPS. System on PS2/UPS2. Services OK during UPS replacement.
					On-Line UPS Systems		
					OK UPS on bypass. System on PS2/Wall. Replace UPS1. Vulnerable to outage during UPS replacement.	OK UPS on bypass. System on Wall. Services down while replacing UPS1.*	OK UPS on bypass. System on PS2/UPS2. Replace UPS1. Services OK during UPS replacement.

* SmartOnline Hot-Swappable UPS Systems (5-20 kVA) include a detachable bypass PDU to permit hot-swap UPS replacement without a service outage. In addition, UPS systems up to 3 kVA can be combined with an external Hot-Swap PDU to provide the same capability.

Multiple Power Supplies Operating in Dual (Combined, Non-Redundant) Mode

STEP 1: Determine Configuration					
Configuration	**1**		**2**	**3**	
Power Supply	PS1	PS2	PS1 & PS2	PS1	PS2
Power Source	Wall	Wall	UPS1	UPS1	UPS2

STEP 2: Consider Failure Scenarios			**STEP 3: Consider System Status**		
PS1 Status	**Utility Status**	**UPS Status**	**System Status**	**System Status**	**System Status**
OK	OK	OK	OK	OK	OK
Failure	OK	OK	Reduced Output	OK	OK
OK	Blackout	OK	Crash	OK	OK
OK	Blackout	UPS1 Battery Fails	Crash	Crash Replace UPS1. Output reduced during UPS replacement.	Reduced output. Replace UPS1. Output reduced during UPS replacement.
OK	Blackout	UPS1 Internal Fault	—	Crash Replace UPS1.	Reduced Output Replace UPS1. Output reduced until UPS1 replacement.
OK	OK	UPS1 Battery Fails	—	OK Hot-swap battery.	OK Hot-swap battery.
OK	OK	UPS1 Internal Fault	—	**Line-Interactive UPS Systems**	
				Crash Replace UPS. Plug into wall until UPS replacement.	Reduced Output Replace UPS1. Plug PS1 into wall to restore full power until UPS1 replacement. Output reduced until UPS1 replacement.
				On-Line UPS Systems	
				OK Replace UPS1. Both PS on UPS Bypass. Services down while replacing UPS1.*	OK Replace UPS1. PS1 on UPS1 Bypass circuit, vulnerable to outage. Reduced power during UPS1 replacement.

* SmartOnline Hot-Swappable UPS Systems (5-20 kVA) include a detachable bypass PDU to permit hot-swap UPS replacement without a service outage. In addition, UPS systems up to 3 kVA can be combined with an external Hot-Swap PDU to provide the same capability.

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Choosing UPS systems that support extended runtime will allow you to add hot-swappable battery capacity at any time by connecting as many external battery packs as you need.

UPS System Battery Configuration

UPS system availability, and therefore VoIP system availability, is most critically dependent upon the capacity of the UPS system's battery configuration. The number and size of UPS system batteries, both internal and external, determine the amount of runtime that is provided during a power outage. As mentioned previously, the runtime must fit the application. Most existing data networks are unlikely to provide reserve runtime power comparable to the public switched telephone network. You must determine a runtime estimate that will be adequate specifically for a VoIP application. Most users conclude that hours, not minutes, of backup runtime are required to maintain voice operations and emergency 911 service.

Like any estimate, a runtime estimate will be imperfect and will also be impacted by future capacity requirements (such as the addition of more phones). Therefore, it is critical that the selected UPS system can accommodate external battery packs to increase runtime as needs increase, or maintain runtime in a growing phone environment.

Providing runtime scalability with external battery packs also yields the ability to hot-swap battery packs at the end of their useful life without a service interruption. Similar hot-swap battery replacement is also the norm for the UPS system's internal batteries.

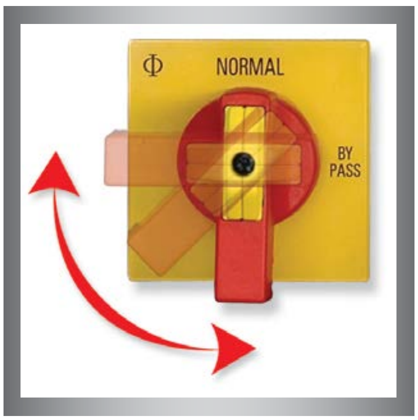
In the event of a power electronics failure or extended overload, an on-line UPS will automatically enter bypass mode and keep the VoIP system powered without interruption through an internal bypass path until the UPS can be repaired or the overload condition corrected.

UPS System Power Electronics

If a UPS system's power electronics fail during a utility power outage, the supported VoIP system will obviously crash. If the UPS system failure occurs while utility power is present, however, different UPS power electronics topologies can impact VoIP system availability in different ways.

On-Line UPS System with Internal Bypass

With power present, an internal power electronics fault in an on-line UPS system will result in the load automatically being powered by a bypass path inside the UPS. As long as utility power remains present, the UPS will continue to power the connected VoIP system without interruption and will continue to condition the power against basic power anomalies. In the event of a power outage, the system will crash. In the event of an internal power electronics fault, a scheduled service interruption will be required to replace the UPS system, unless the UPS is connected to an external Hot-Swap PDU, which is an option available for UPS systems up to 3 kVA.



SmartOnline Hot-Swappable UPS Systems (5-20 kVA) include a detachable bypass PDU. The bypass PDU can be electrically and physically separated from the rest of the UPS system by turning the manual bypass switch and loosening several screws. This allows you to hot-swap the power module and perform UPS maintenance, repair or replacement without scheduling a VoIP service outage.

With power present, a battery system failure will not cause a system interruption. As long as utility power remains present, the UPS system will continue to power the connected VoIP system without interruption and will continue to condition the power against most power anomalies. In the event of a power outage, the system will crash. The internal batteries of the UPS system and/or the external battery packs are hot-swappable and can be replaced without a service interruption.

On-Line UPS System with Internal Bypass and Detachable Bypass PDU

With power present, an internal power electronics fault will result in the load automatically being powered by a bypass path inside the UPS. As long as utility power remains present, the UPS will continue to power the connected VoIP system without interruption and will continue to condition the power against basic power anomalies. In the event of a power outage, the system will crash.

In the event of an internal power electronics fault, the power module of the UPS should be replaced. This can be performed while the system remains in service, as the input and output power connections are built into the detachable bypass PDU, where they can be physically and electrically separated from the power module itself without disconnecting supported equipment or interrupting AC output. SmartOnline Hot-Swappable UPS Systems (5-20 kVA) include this functionality.

With power present, a battery system failure will not cause a system interruption. As long as utility power remains present, the UPS system will continue to power the connected VoIP system without interruption and will continue to condition the power against most power anomalies. In the event of a power outage, the system will crash. The internal batteries of the UPS system and/or the external battery packs are hot-swappable and can be replaced without a service interruption.

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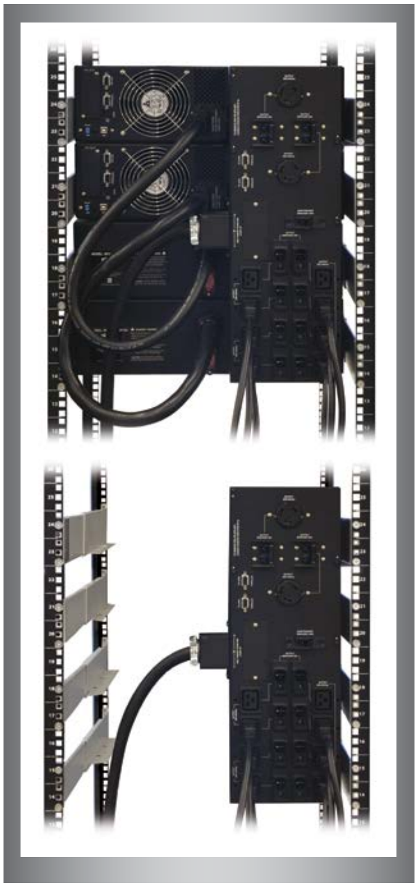
On-Line UPS System with Internal Bypass, Detachable Bypass PDU and N+1 Redundancy



SmartOnline Hot-Swappable N+1 UPS Systems (12-20 kVA) include dual hot-swappable power modules and a detachable bypass PDU. When the connected equipment load is less than or equal to 50%, the UPS system provides power module redundancy and added resilience. In addition, the bypass PDU can be electrically and physically separated from the rest of the UPS system by flipping the manual bypass switch and loosening several screws. This allows you to hot-swap the power modules and perform UPS maintenance, repair or replacement without scheduling a VoIP service outage.

SmartOnline Hot-Swappable N+1 UPS Systems (12-20 kVA) have dual hot-swappable power modules and a detachable bypass PDU. Dual power modules allow the UPS system to provide power module redundancy and added resilience when the load is less than or equal to 50% of capacity. When the load is greater than 50% of capacity, the UPS system does not provide power module redundancy, but it still provides hot-swap capability.

With power present and a load less than or equal 50% of capacity, an internal power electronics fault in one of the dual power modules will result in the load automatically being powered by the redundant power module. Regardless of whether utility power remains present, the UPS will continue to power the connected VoIP system without interruption and will continue to provide full on-line protection. In the event of a power outage, the VoIP system will remain fully supported and protected.

With power present and a load greater than 50% of capacity, an internal power electronics fault in one of the dual power modules will result in the load automatically being powered by a bypass path inside the UPS. As long as utility power remains present, the UPS will continue to power the connected VoIP system without interruption and will continue to condition the power against basic power anomalies. In the event of a power outage, the system will crash.

In the event of an internal power electronics fault in one of the dual power modules, the faulty power module should be replaced. This can be performed while the system remains in service, as the input and output power connections are built into the detachable bypass PDU, where they can be physically and electrically separated from both of the power modules simultaneously without disconnecting supported equipment or interrupting AC output.

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With power present, a battery system failure will not cause a system interruption. As long as utility power remains present, the UPS system will continue to power the connected VoIP system without interruption and will continue to condition the power against most power anomalies. In the event of a power outage, the system will crash. The internal batteries of the UPS system and/or the external battery packs are hot-swappable and can be replaced without a service interruption.

Line-interactive UPS systems do not offer as much protection as on-line UPS systems, but they typically offer lower cost and high efficiency. Because they have fewer electronic components and simpler operational requirements, they also have a very low incidence of internal power electronics faults.

Line-Interactive UPS System

With power present, an internal power electronics fault can result in the system crashing. Because the operational requirements of a line-interactive UPS system are very simple when power is present, this is extremely rare. Line-interactive power electronics failures are normally detected only when the power fails and the UPS attempts to power the load from its battery-driven inverter.

In the event of a power electronics failure, a service interruption must be scheduled to replace the UPS system.

With power present, a battery system failure will not cause a system interruption. As long as utility power remains present, the UPS system will continue to power the connected VoIP system without interruption and will continue to condition the power against many power anomalies. In the event of a power outage, the system will crash.

The internal batteries of the UPS system and/or the external battery packs are hot-swappable and can be replaced without a service interruption.

Resilience

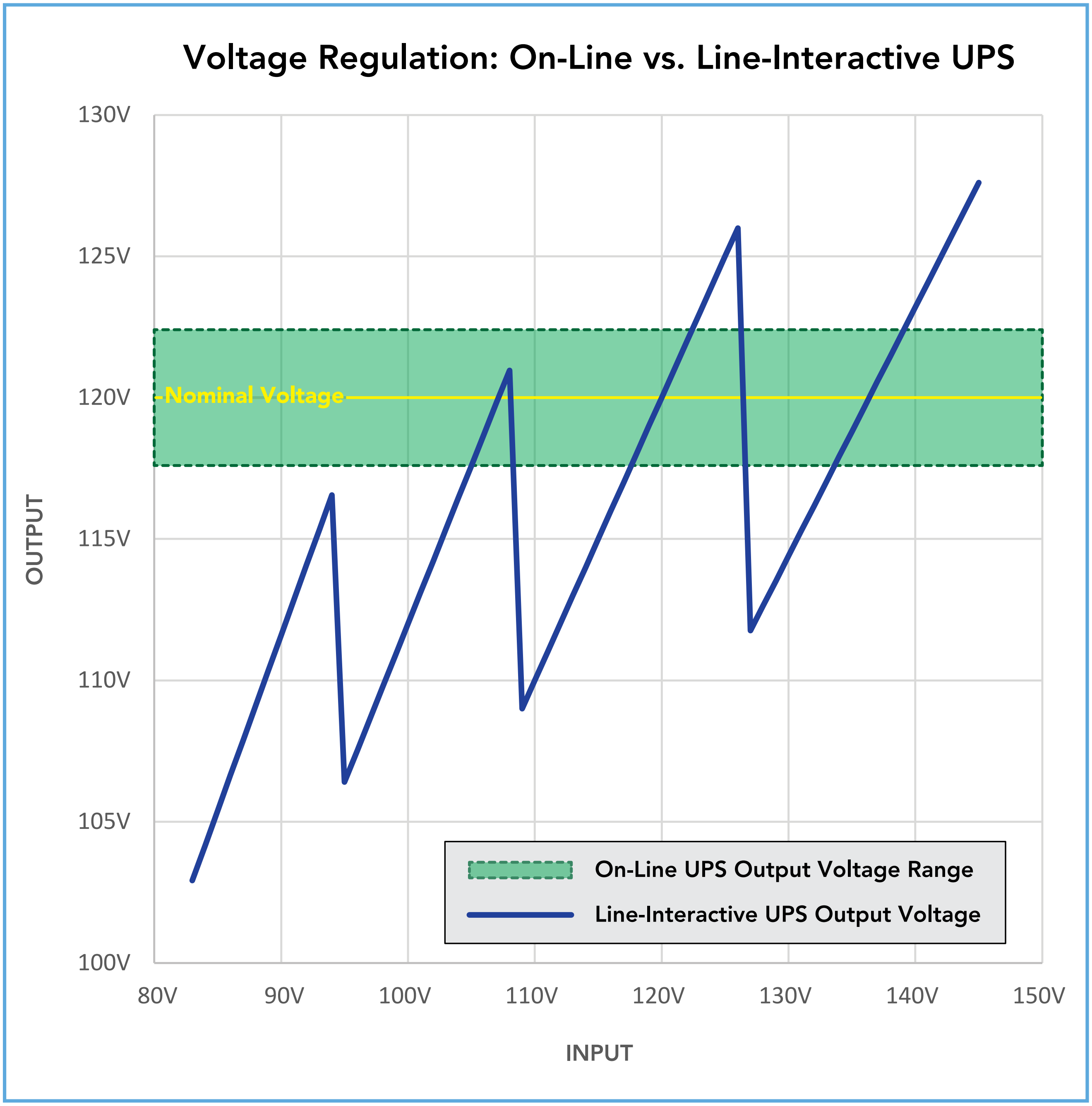
The primary goal of adding UPS system support to a network is to increase system availability, but it is not the only goal. Resilience is also very important. Resilience is the ability of a UPS system, and by extension the VoIP equipment it supports, to withstand power problems without interrupting or degrading normal operation. Generally speaking, on-line UPS systems offer greater resilience and line-interactive UPS systems offer lower acquisition cost.

Voltage Variation

One of the most popular UPS system topologies for VoIP is provided by on-line UPS systems. An on-line UPS system can deliver perfect power even if it encounters a very wide range of input voltages. The on-line UPS does this without relying on its battery reserves, leaving it well prepared to respond to a power outage. Because of its continuous AC-DC-AC double-conversion process, an on-line UPS system also exhibits zero transfer time between power failure detection and power delivery to your equipment during an outage. On-line UPS systems are widely acknowledged to be compatible with all types of VoIP devices.

One of the most popular UPS system topologies for VoIP is provided by on-line UPS systems. On-line UPS systems are widely acknowledged to be compatible with all types of VoIP devices.

In many networks with distributed UPS systems, line-interactive UPS systems are widely deployed. If input voltage levels are above or below the line-interactive UPS system's automatic correction capability, the UPS will switch to battery to maintain acceptable output voltage. In areas with chronic extreme brownouts, this frequent switching to battery can reduce reserve power as well as shorten battery service life, which puts critical systems at greater risk in an outage. The voltage correction of a line-interactive UPS system (known as automatic voltage regulation or AVR) is also less precise than an on-line UPS system. A line-interactive UPS system typically provides output voltages within ±10-15% of the nominal voltage while an on-line UPS system typically provides output voltages within ±2-3% of the nominal voltage. In practice, both types of UPS systems provide output voltages that are well within the tolerances of the power supplies of most IT equipment.



A line-interactive UPS system typically provides output voltages within ±10-15% of nominal while an on-line UPS system typically provides output voltages within ±2-3% of nominal. In practice, both types of UPS systems provide output voltages that are well within the tolerances of the power supplies of most VoIP equipment. An additional advantage of on-line UPS systems that is not reflected in the area covered by the chart above is their ability to correct very low voltages without switching to battery power, especially when operating at lower load levels.

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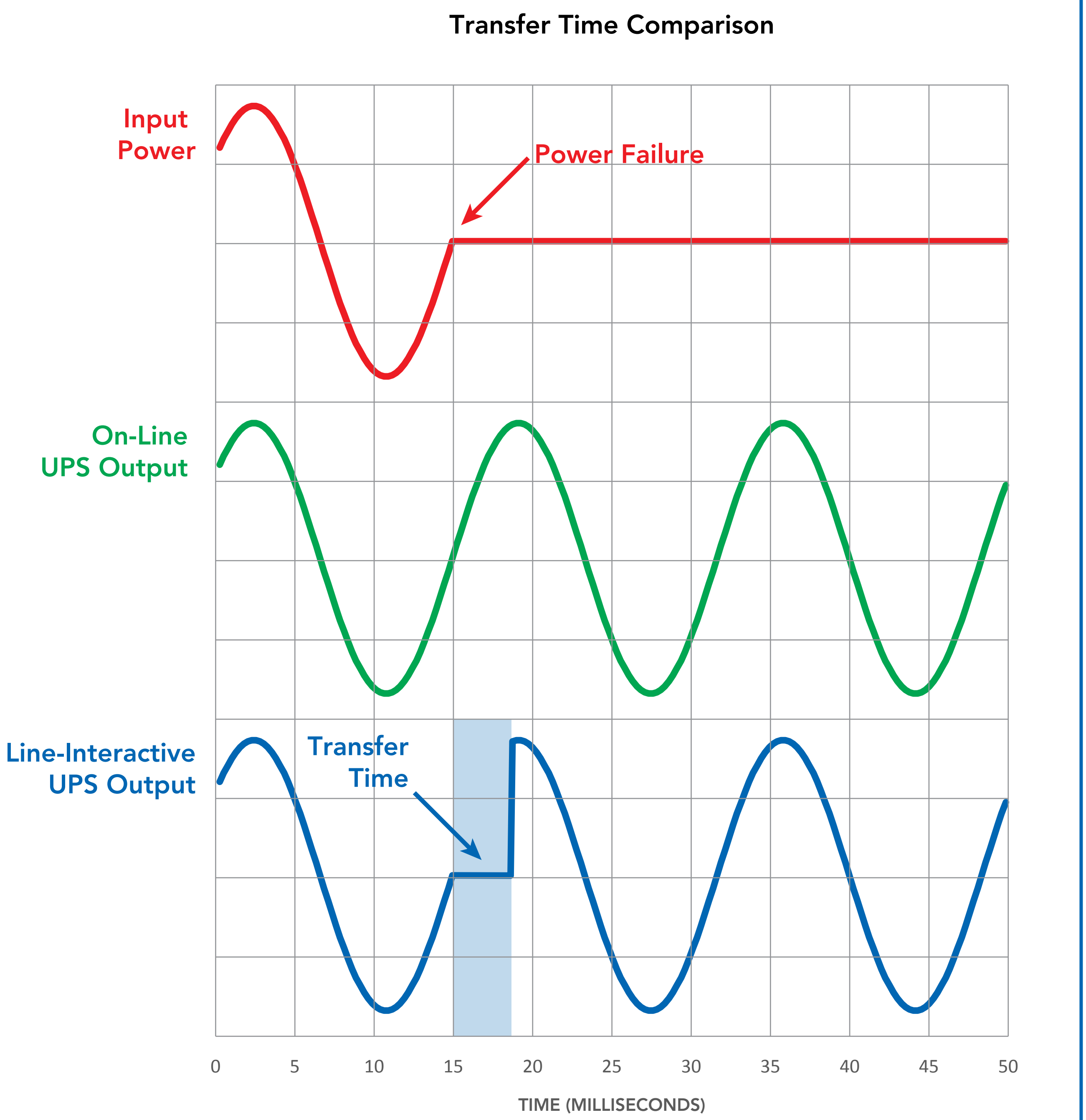

Because of its continuous AC-DC-AC conversion process, an on-line UPS system has zero transfer time between a power failure and the delivery of battery backup power. On-line UPS systems are widely acknowledged to be compatible with all types of VoIP equipment. The transfer time of a line-interactive UPS system is extremely fast (several milliseconds) and does not pose a problem for most equipment and applications. The transfer time could potentially cause packet losses or system shutdown in some applications, but this is unusual. Depending on your power environment and the sensitivity of your VoIP equipment, a line-interactive UPS system may or may not be suitable.

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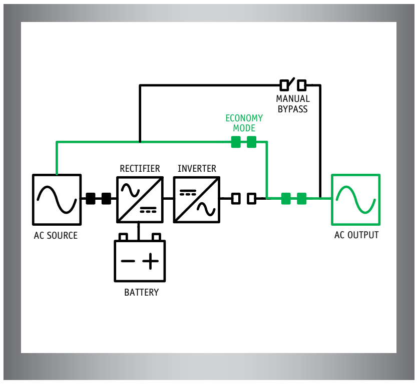
While the transfer time of a line-interactive UPS system (several milliseconds) is extremely fast, this short delay has been theorized as the cause of packet losses, or even system shutdown, in some applications. Depending on your power environment and the sensitivity of your VoIP components, a line-interactive UPS system may or may not be suitable. Generally, line-interactive UPS systems do not pose a problem.



Many on-line UPS systems can operate in economy mode to increase efficiency and reduce energy costs. In economy mode, the on-line UPS operates with increased efficiency while input power quality is good. If input power quality worsens, the UPS automatically resumes double conversion to provide maximum protection.

Line-interactive UPS systems typically cost less than on-line UPS systems and operate with higher efficiency, reducing electrical costs. However, many on-line UPS systems can operate in economy mode to increase efficiency and reduce energy costs. In economy mode, the on-line UPS operates with increased efficiency while input power quality is good. If input power quality worsens, the UPS automatically resumes AC-to-DC-to-AC double conversion to provide maximum protection. When operating in economy mode, an on-line UPS still provides more protection than a line-interactive UPS, while increasing efficiency to a similar level.

In theory, an on-line UPS system battery should also be used less frequently to respond to input voltage variation, and will therefore last longer than a line-interactive UPS system battery. This advantage will become more apparent as the rate of input voltage variation increases.

Harmonic Distortion

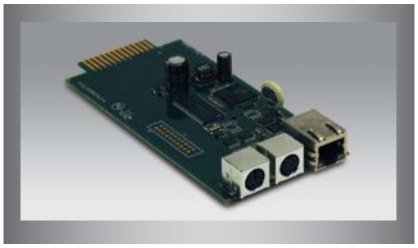
Only an on-line UPS system will address input harmonic distortion. Because an on-line UPS system deconstructs and reconstructs the input power, it can deliver distortion-free power. A line-interactive UPS system will pass through input waveform distortions. Harmonic distortion tends to be an elusive "gremlin" issue when it affects connected loads.

Transient Spikes (or "Surges")

Both line-interactive and on-line UPS systems protect against transient spikes and surges on the AC line. Some models also include data line surge protection.

Electromagnetic Interference

While both line-interactive and on-line UPS systems address phenomena such as EMI/RFI noise, on-line UPS systems typically offers far superior filtering capability.



Whether you choose to manage UPS systems through IP network accessory cards (SNMPWEBCARD), free PowerAlert® software or both, Tripp Lite provides a single JAVA®-based interface for VoIP applications of all scales across multiple OS platforms.

Manageability

VoIP system availability is closely tied to UPS system manageability. To ensure continuous availability, UPS systems must be incorporated as an integral part of a comprehensive hardware management scheme. UPS systems are extremely manageable and responsive, communicating their status automatically and triggering application shutdowns prior to battery exhaustion in the event of an extended power outage or extreme voltage variation.

There are various methods to communicate with UPS systems, including SNMP, Web, SSH, telnet and direct connection. While most users choose network accessory cards installed inside UPS systems for communication, the most essential requirement is to deploy and use some method of communication. Without a management application running for your UPS systems, the day will come when the UPS batteries fail and your system fails during a power outage. Simple management steps taken at installation can eliminate significant problems later.

Alerts available from most UPS systems and network accessory cards include:

- Voltage levels
- Current/load levels
- Temperature levels
- Humidity levels
- Dry contacts for fire, water, security alarms
- Battery capacity
- Battery failure
- UPS operating mode/power status (such as on-line, bypass, economy, on battery)

Commands from the administrator to most UPS systems include:

- Reboot UPS system
- Shut down UPS system
- Run inverter/battery test
- Switch outlet(s) on/off
- Activate/deactivate economy mode

You can connect an optional environmental sensor (ENVIROSENSE®) to each SNMPWEBCARD to monitor temperature, humidity and dry-contact communications over the network.

Management Tools

Tripp Lite presents a uniquely simple management scheme for VoIP UPS System hardware. Whether management is through an IP-addressed network accessory card (SNMPWEBCARD) or free PowerAlert software, Tripp Lite provides administrators with a single JAVA®-based user interface. The commonality within this design approach makes it ideal for managing VoIP applications of all scales across multiple OS platforms. During an extended power failure, PowerAlert software ensures a smooth and customizable shutdown of call-processing and voice messaging applications as well as the underlying operating system.

PowerAlert software and SNMPWEBCARD are designed to accommodate multiple power supply and UPS system hardware deployments. With a single IP address assigned to the SNMPWEBCARD (or a single computer running PowerAlert), users can manage multiple redundant UPS systems. Other UPS system manufacturers require each UPS to be managed individually. With these UPS systems, there is no easy way to manage redundant operation without expensive and space-consuming external power-switching accessories.

Watchdog service monitoring/rebooting software is another Tripp Lite management solution that reduces call-processing server downtime. Watchdog automatically reboots locked-up or poorly performing system service applications. If a locked service cannot be rebooted, Watchdog will automatically direct PowerAlert to reboot the server. If the server is unresponsive, the UPS system will power down and then restart the attached devices.

SmartOnline and SmartPro UPS systems and PowerAlert software have undergone interoperability testing as part of an integrated VoIP power solution by Tripp Lite together with Cisco and a third-party test house based on testing criteria set by Cisco.

Cisco® Compatibility

Tripp SmartOnline and SmartPro UPS systems and PowerAlert software have undergone interoperability testing as part of an integrated VoIP power solution by Tripp Lite together with Cisco and a third-party test house based on testing criteria set by Cisco. Tripp Lite is also a member of the Cisco Developer Network, a technology partner program that allows members to leverage Cisco technologies to develop compelling business solutions to meet customer needs.

Note: Tripp Lite is solely responsible for the support and warranty of its product. Cisco makes no warranties, express or implied, with respect to Tripp Lite's product or its interoperation with the listed Cisco product(s) and disclaims any implied warranties of merchantability, fitness for a particular use, or against infringement.

Selecting UPS Systems for VoIP Applications

Establishing a satisfactory power protection and backup power infrastructure is essential to building a successful VoIP network. As discussed earlier, three areas of demand must be addressed: client devices, network devices and call-processing devices.

If an IP phone is powered through the network line (Power over Ethernet or PoE), it is supported by the PoE network switch. In this case, UPS backup will be provided at the switch and is not required at the phone. If the phone plugs into an AC outlet, UPS backup is required at the phone.

Special Considerations for Client Devices (IP Phones, PC-Based Soft Phones, etc.)

IP Phones

If the IP phone is powered through the network line (Power over Ethernet or PoE), it is supported by the PoE network switch. In this case, UPS backup will be provided at the switch and is not required at the phone.

If the phone plugs into an AC outlet, UPS backup is required at the phone. Although you can use the same UPS system to support a phone and a computer system located at the same desk, you need to make sure the UPS system will provide enough capacity and runtime for all the equipment connected to it. If you wish to provide several hours of runtime for the phone, but only a few minutes for the computer, you should either use separate UPS systems or use PowerAlert software to ensure that the computer is set to automatically save open files and shut down gracefully when an outage lasts longer than a few minutes.

Soft Phones

If the soft phone application is resident on a desktop computer, UPS support is typically required. If the soft phone application is resident on a laptop computer, the laptop's internal battery should last for at least a few hours. If you wish to provide additional runtime beyond the laptop's internal battery capacity, UPS support is required. If you do not wish to provide additional runtime, use a surge protector to shield the laptop's power supply from transient surges and line noise.

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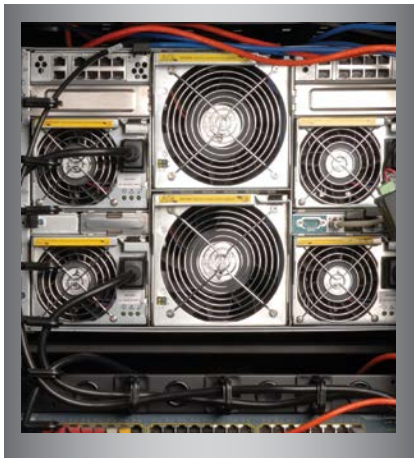


Most large servers, switches and routers have multiple power supplies to provide additional fault tolerance. When selecting UPS systems to support equipment with multiple power supplies, you need to decide whether you will connect the power supplies to a single UPS or connect each power supply to a separate UPS for higher availability.

Special Considerations for Network Devices (Switches, Routers, etc.)

Network hardware will typically drive the most significant changes to your existing power infrastructure. With requirements spanning buildings and remote wiring closets, existing facility-wide backup plans are often impractical or unable to address the requirements of mid-size and large switches. Focused UPS system additions with extended runtime battery configurations add the high level of availability that VoIP users demand without wasting resources where they are not required.

Special Considerations for Call-Processing Devices (Servers and Related Storage Systems)

When transitioning to VoIP, you will typically add server and storage resources to handle call processing, voice messaging and other telephony applications. These systems are usually located in the data center, so it's important to consider their UPS backup power within the context of the data center's overall power infrastructure and backup power scheme.

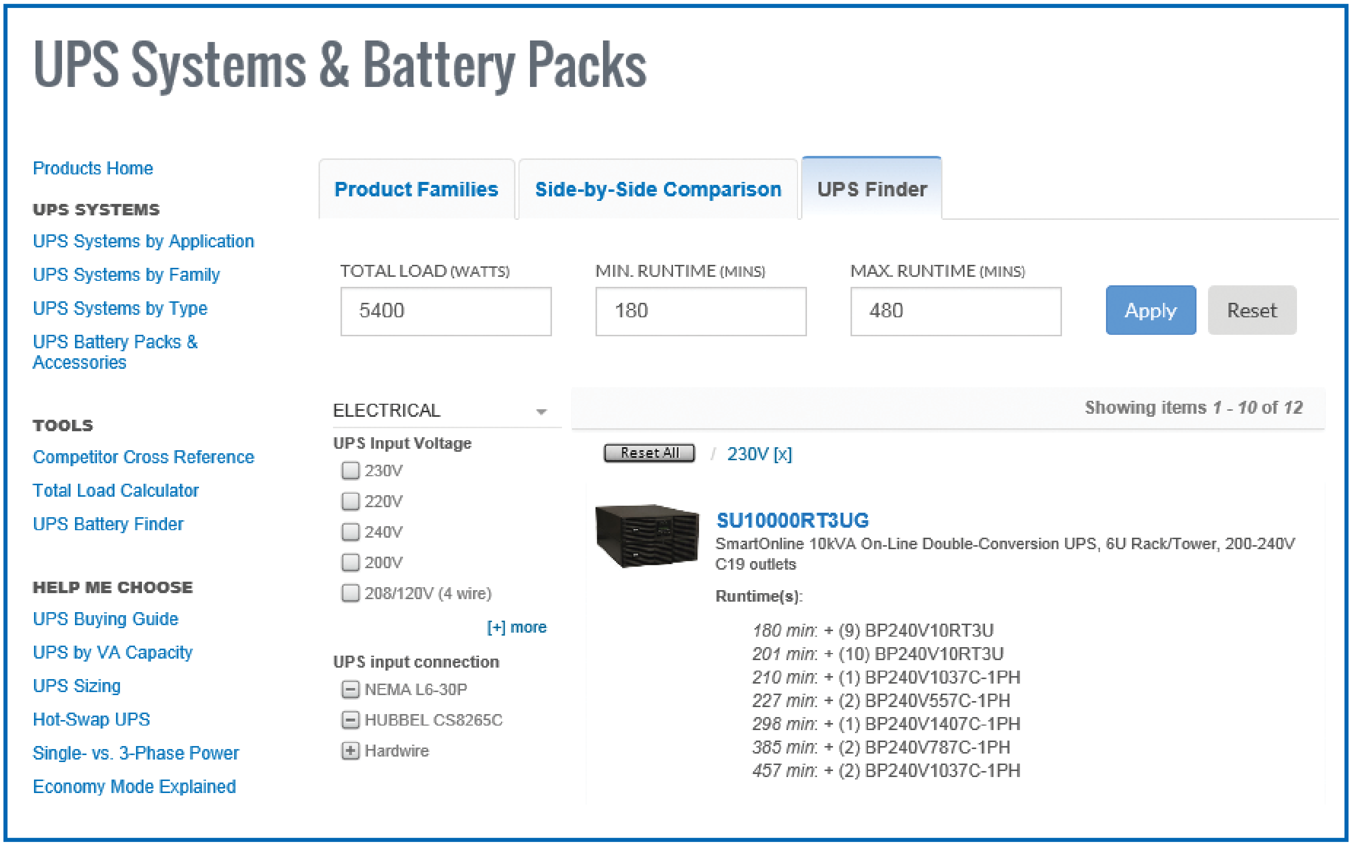
How Much UPS Capacity Do You Need?

Basic sizing is as simple as determining the power consumption of your equipment and ensuring that each UPS system has enough power capacity, the correct voltage and sufficient outlets to accommodate all the equipment that will be connected to it. (You can also incorporate PDUs to provide additional outlets, placement flexibility and management features.) Check the UPS system's specifications to make sure the UPS system can connect to a compatible AC circuit/outlet in the installation location, or you may need to have an electrician install a new one.

Remember that most large servers, routers and switches have multiple power supplies to provide additional fault tolerance. Using the guidelines in the **Availability** section, you need to decide whether you will connect the power supplies to a single UPS or connect each power supply to a separate UPS for higher availability.

Refer to the equipment manufacturer's documentation to find the wattage for each device. If it lists power requirements in amps, multiply by the AC voltage to estimate wattage. You can also refer to the equipment nameplate for this information.

Although this method provides a rough estimate of wattage power, we recommend that you use the UPS finder at **www.tripplite.com/upsfinder** to provide a more precise estimate. If you have additional questions, our technical support staff is on hand to provide expert assistance.



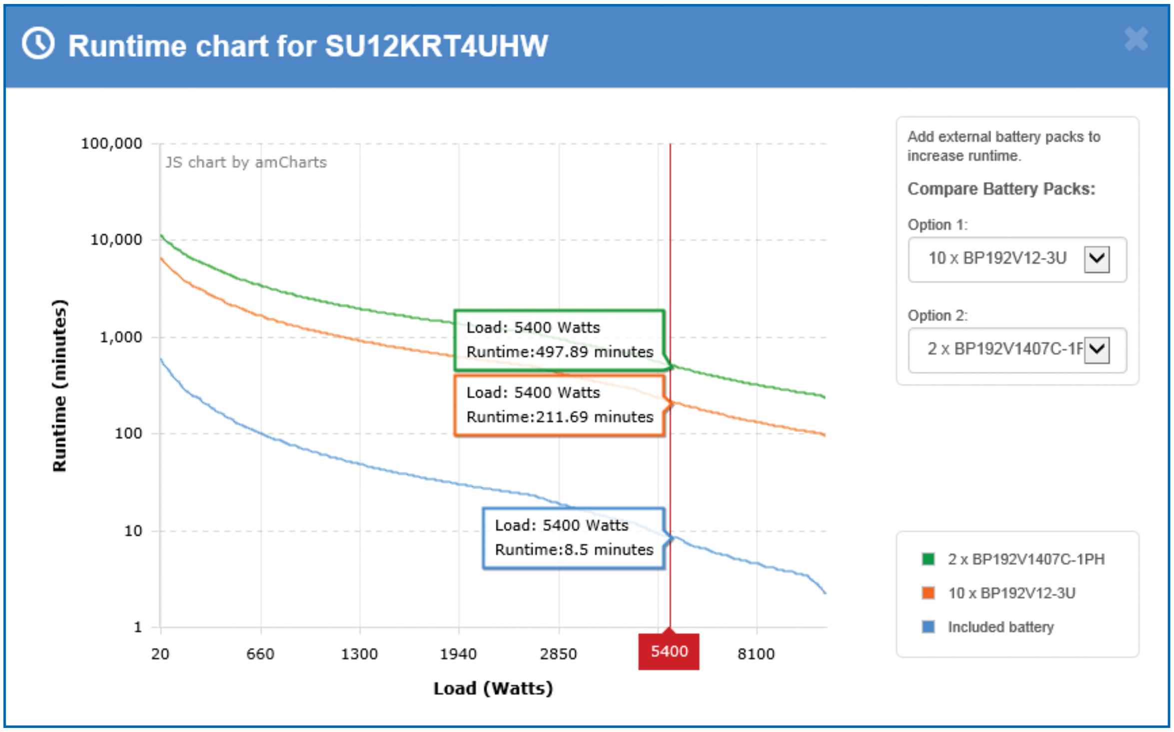
Visit **www.tripplite.com/upsfinder** to access Tripp Lite's interactive UPS finder.

How Much Battery Backup Runtime Do You Need?

With an 80% load, included UPS batteries typically provide five to ten minutes of runtime. As we've outlined in this document, VoIP applications typically require several hours of runtime to support emergency 911 service and dial tone availability during extended power outages.

If you're connecting more than a single IP phone to the UPS system, choose a UPS system that supports connecting external battery packs. This will allow you to extend runtime beyond the UPS system's included battery capacity and provide hours of runtime during an outage. In many cases, you'll need to connect more than one external battery pack, so you should choose battery packs that support daisy-chaining. By daisy-chaining multiple battery packs, you can extend runtime to match any practical requirement.

Go to **www.tripplite.com** for interactive battery backup runtime charts for every UPS model. You can see how different battery pack configurations affect runtime at any wattage level and easily compare different configurations to determine which one fits your application best. The UPS finder also allows you to specify runtime requirements and list battery pack options that match the requirements. If you have questions, our technical support staff is on hand to provide expert assistance.



Go to **www.tripplite.com** for interactive runtime charts for every UPS model.

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Our interactive UPS finder and runtime charts may give you all the information you need to choose a UPS system, but it's hard to replace the assistance of an experienced power professional. Tripp Lite's technical support staff is available to help you free of charge. If you're located in the U.S., call ***773.869.1773*** *(8-6 CST, M-F) or e-mail* ***presaleshelp@tripplite.com****. If you're located outside the U.S., call* ***+1.773.869.1212*** *or e-mail* ***intlservice@tripplite.com.***

Expert Assistance from Experienced Professionals

Our interactive UPS finder and runtime charts are very helpful and may give you all the information you need to choose a UPS system. But we recognize that it's hard to replace the assistance of an experienced power professional, especially when you're dealing with a more complex VoIP rollout. Tripp Lite's technical support staff is available to help you with all your VoIP backup power requirements free of charge.

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About Tripp Lite

Customers in the IT, telecom, industrial, commercial, corporate, healthcare, government and education sectors choose Tripp Lite for complete solutions to power, protect, connect and manage servers, network hardware and other equipment in data centers and related facilities. Tripp Lite makes more than 2,500 products, including UPS systems, battery packs, PDUs, rack enclosures, cooling solutions, surge protectors, KVM switches, cables, power strips and inverters. For more information about Tripp Lite's full line of solutions for VoIP and Internet telephony applications, visit www.tripplite.com.

OVER 90 YEARS
Manufacturing Excellence.

1 Cisco White Paper: "The Transition to IP Telephony at Cisco Systems"
2 Source: Cisco Systems, Inc.