



Top 12 Questions to Consider When Choosing UPS Systems for Network/Server Applications

Executive Summary

One of the fundamental decisions in the design of data centers, server rooms and network closets is which uninterruptible power supply (UPS) systems to use. You cannot be certain that the power you receive from your local utility will be suitable for your equipment, or that it will always be available. And even when you are receiving good-quality power from the utility, equipment inside your facility (such as electric motors) can introduce power problems.

A network/server UPS system conditions input power 24x7 to ensure that your equipment always receives reliable power and protection from damaging and disruptive power problems. A network/server UPS system also supports your equipment during power failures, providing enough battery backup runtime to outlast shorter outages. During longer outages, the UPS system will provide enough runtime to save files and gracefully shut down systems or to ensure that equipment is powered until standby generators are ready to support the load.

Choosing the right UPS system can improve system availability and save your organization from the high cost and inconvenience of downtime, as well as deliver significant savings through improved energy efficiency. How can you determine which UPS is appropriate for your application? Here are the top 12 questions you should consider to help you choose the right network/server UPS system.

Table of Contents

| | |
|--|----|
| Do you need a network/server UPS? | 3 |
| How much UPS capacity (wattage) do you need? | 4 |
| Estimating Capacity Requirements..... | 4 |
| High-Capacity Applications..... | 4 |
| High Power Factor..... | 4 |
| Which input and output power connections do you need? | 5 |
| UPS Input..... | 5 |
| UPS Output..... | 5 |
| How can you make sure you have enough backup runtime? | 5 |
| Expandable-Runtime UPS Systems | 5 |
| Load Shedding | 5 |
| Should you choose a line-interactive or on-line UPS? | 6 |
| UPS Topology | 6 |
| Voltage Regulation | 6 |
| Surge/Noise Protection | 6 |
| Pure Sine Wave Output..... | 6 |
| Transfer Time to Battery..... | 7 |
| How much space do you need for the UPS? | 7 |
| Which UPS features will help you improve system availability? | 7 |
| On-line Operation | 7 |
| Hot-Swappable Power Modules..... | 7 |
| Hot-Swap PDUs | 8 |
| Power Redundancy..... | 8 |
| Wide Input Voltage Range | 8 |
| Automatic Bypass | 8 |
| Hot-Swappable Batteries..... | 8 |
| Overload Capacity..... | 8 |
| How can you save energy without compromising protection? | 9 |
| UPS Efficiency..... | 9 |
| Economy Mode Operation..... | 9 |
| How often should you replace UPS batteries? | 9 |
| Battery Replacement..... | 9 |
| Replacing Batteries Versus Replacing the UPS..... | 9 |
| How will you manage the UPS system? | 10 |
| Control Panel..... | 10 |
| Remote Management Options..... | 10 |
| Centralized Management..... | 10 |
| Emergency Power Off | 10 |
| How can you reduce installation and maintenance costs? | 11 |
| Self-Service | 11 |
| 3-Phase UPS Installation | 11 |
| Where can you find more UPS advice if you need it? | 11 |
| Making the Right Choice..... | 11 |
| Working with a Dependable Partner | 11 |
| About Tripp Lite | 12 |

1 Do you need a network/server UPS?

Network/server UPS systems protect critical systems in high-availability environments, like servers and network equipment in data centers. Desktop UPS systems protect personal computers, workstations, small file servers, peripherals, audio/video equipment and other electronics in your home or office. You may already be certain that you need a network/server UPS system for your application rather than a desktop UPS system. If you aren't sure, however, the questions below will help you make the right choice. If your answer to any of these questions is yes, you should choose a network/server UPS system.

- **Will the UPS support mission-critical equipment?**

Mission-critical equipment cannot experience unplanned downtime without disrupting organizational productivity. Examples: Servers, network/telecom hardware and factory equipment.

- **Will the UPS support a load higher than 750 watts?**

Not many desktop UPS systems have a capacity higher than 750 watts, and standard practice is to limit loads to 80% of maximum capacity. This helps the UPS handle fluctuations in power demand, leaves headroom for additional equipment and reduces the chance of overloads.

- **Will your equipment be installed in a rack or rack enclosure?**

A few desktop UPS systems support rack installation, but a wide range of network/server UPS systems are optimized for rack installation and include all the required mounting hardware.

- **Does your equipment need pure sine wave power?**

Some equipment prefers or requires that the UPS system provide pure sine wave power when operating from battery. Many network/server UPS systems do this.

- **Do you need to manage the UPS remotely?**

Most UPS systems can be managed through their communication ports and a connected computer. Most network/server UPS systems include a slot for an internal network management card, and some include a pre-installed card.

- **Do you want to extend the UPS system's runtime on battery?**

Many network/server UPS systems support optional external battery packs that allow the UPS to provide additional runtime. Only a few desktop UPS systems support external battery packs.

- **Does your equipment require high-voltage (200-250 VAC) power in North America?**

In North America, desktop UPS systems do not support high-voltage operation. Many network/server UPS systems support either high-voltage operation or a combination of high- and low-voltage operation.

2 How much UPS capacity (wattage) do you need?

Estimating Capacity Requirements

If the total current drawn by connected equipment exceeds the UPS system's capacity, the UPS becomes overloaded. If the UPS is overloaded, it will drop the load during an outage instead of switching to battery mode. You can estimate your UPS capacity requirement by totaling the wattage requirements of all the equipment you plan to connect to the UPS system. You should refer to the equipment manufacturer's documentation to find the wattage. If you can't find any printed or online documentation, refer to the equipment nameplate. If your equipment lists its power requirements in amps, multiply the number of amps by the AC voltage to estimate wattage.

Refer to the UPS specifications to find models with capacities higher than your total wattage requirement. UPS systems are typically marketed by their VA rating, but the capacity in watts should also be listed. (Keep in mind that UPS manufacturers typically recommend limiting IT equipment loads to 80% of capacity. This helps the UPS handle fluctuations in power demand, leaves headroom for additional equipment and reduces the chance of overloads.)

Note: Although this method will provide a rough estimate of your UPS capacity requirements, we recommend that you confirm your estimate with the UPS manufacturer or reseller.

High-Capacity Applications

If your capacity requirement exceeds 16,000 watts, you may wish to consider a 3-phase UPS system, or you can divide your equipment into smaller groups to be supported by multiple single-phase UPS systems. (If your equipment is distributed across a wide area, multiple single-phase UPS systems may be required regardless.) 3-phase power costs more to install than single-phase power, but it can be more efficient for high-capacity loads.

High Power Factor

Some network/server UPS systems have a high power factor that makes more efficient use of your facility's power infrastructure and available space, allowing you to connect more equipment to each UPS system and circuit. While a 10,000 VA UPS with a 0.7 power factor will support a 7,000-watt load, a 10,000 VA UPS with a 0.9 power factor will support a 9,000-watt load, an increase of 2,000 watts without a corresponding increase in circuit requirements.

3 Which input and output power connections do you need?

UPS Input

First, you need to make sure the UPS system will be able to connect to a compatible AC circuit in the installation location, including a compatible outlet if the UPS has an input plug. If a compatible circuit is not available, you will need to make arrangements to have one installed or to choose a UPS system that is compatible with an existing circuit. Installing a new circuit can be a relatively simple task for an electrician or it can be a more complex task that requires the services of the power company if you need to have 3-phase power routed to a building that does not already have it.

UPS Output

You also need to make sure the UPS output matches the input plugs and voltage requirements of your equipment. You can provide additional outlets, placement flexibility and management options by connecting one or more power distribution units (PDUs) to the UPS. Some UPS systems are capable of providing low- and high-voltage output simultaneously to support a wider range of equipment. Adding a step-down transformer to a high-voltage UPS can also provide low-voltage output.

4 How can you make sure you have enough backup runtime?

Expandable-Runtime UPS Systems

The UPS manufacturer should provide detailed runtime data for the UPS system within the range of load levels it can support. If the network/server UPS system has an 80% load, the included batteries typically provide sufficient backup runtime to support uninterrupted operation during outages lasting five to ten minutes. Many network/server UPS systems can also connect to one or more optional external battery packs to extend runtime. External batteries are large, costly and require periodic replacement, so it pays to provide a reasonable estimate of your runtime requirements. If your application requires an extremely long runtime, you may wish to contact the UPS manufacturer for a custom runtime solution or supplement the UPS system with a standby generator.

Load Shedding

Load shedding allows you to prioritize the battery backup runtime of your critical equipment by automatically turning off nonessential equipment during longer outages. Network/server UPS systems or connected PDUs that have controllable outlets allow you to set up load shedding. For example, if you have ten nonessential devices and four essential devices connected to a 2,200 VA UPS, and each device uses 100 watts, you can increase available runtime from six minutes to more than half an hour by turning off the nonessential devices during an outage.

5 Should you choose a line-interactive or on-line UPS?

UPS Topology

The two main types of operation (known as the UPS system's topology) used in network/server UPS systems are line-interactive and on-line. At the most basic level, line-interactive UPS systems are less expensive than on-line UPS systems (approximately 20 to 40% less, depending on the model and manufacturer), but they also provide less protection than on-line UPS systems. It's helpful to explore the differences between line-interactive and on-line models to understand the trade-offs involved.

Note: If you need a UPS system larger than 5,000 VA (4,000 watts), an on-line UPS is your most likely choice.

Voltage Regulation

Line-interactive UPS systems use automatic voltage regulation (AVR) to correct abnormal voltages without switching to battery. (Regulating voltage by switching to battery drains your backup power and can cause batteries to wear out prematurely.) The UPS detects when voltage crosses a preset low or high threshold value and uses transformers to boost or lower the voltage by a set amount to return it to the acceptable range.

On-line UPS systems use a more precise method of voltage regulation: they continuously convert incoming AC power to DC power and then convert the DC power to ideal AC output power. This continuous double-conversion operation isolates connected equipment from problems on the AC line, including blackouts, brownouts, overvoltages, surges, line noise, harmonic distortion, electrical impulses and frequency variations.

In "line" mode (i.e. when not operating from battery), line-interactive UPS systems typically regulate output within $\pm 10\text{-}15\%$ of the nominal voltage (e.g. 120, 208, 230 or 240 volts). When operating from battery, line-interactive UPS systems typically regulate output within $\pm 5\%$ of the nominal voltage. On-line UPS systems typically regulate voltage within $\pm 2\text{-}3\%$ of the nominal voltage at all times.

Surge/Noise Protection

All Network/Server UPS Systems include surge suppression and line noise filtering components to shield your equipment from damage caused by lightning, surges and electromagnetic (EMI/RFI) line noise. On-line UPS systems offer superior protection because the double-conversion operation isolates equipment from problems on the AC line.

Pure Sine Wave Output

When operating from battery power, a line-interactive UPS system generates the waveform of its AC output. An on-line UPS does this continuously. All on-line and many line-interactive UPS systems have pure sine wave output. Pure sine wave output provides maximum stability and superior compatibility with sensitive equipment. Pure sine wave power is required by some equipment power supplies and prevents others from overheating, malfunctioning or failing prematurely.

Transfer Time to Battery

During an outage, line-interactive UPS systems typically transfer from line power to battery-derived power within two to four milliseconds, which is more than fast enough to keep all but a small percentage of the most power-sensitive equipment operating without interruption. On-line UPS systems do not have a transfer time because the inverter is already supplying power to the connected equipment load when an outage occurs.

6 How much space do you need for the UPS?

Space is a factor that seems obvious, but it's easy to overlook. If you already have a site picked out, you need to make sure the UPS will fit. If you're planning a new site, you need to make sure your plans include enough space for the UPS, including the size and weight of all the batteries you'll need to meet your runtime requirements. Most single-phase UPS systems up to 20 kVA can be installed in a rack or rack enclosure, so make sure there will be enough open rack units available. And don't forget to consider the depth of the UPS cabinet. 3-phase UPS systems 20 kVA and above are typically housed in tower cabinets that can be located near the racks or in another room, depending on your preferences. You'll also need to account for any PDUs, bypass panels, power distribution cabinets, power cables, cable managers and other accessories that you plan to add to your UPS system.

7 Which UPS features will help you improve system availability?

Network/server UPS systems offer outstanding power protection, but they shouldn't stop there. They should also incorporate high-availability and fault-tolerance features that help you avoid network downtime, which can cost an average of \$70,000 per hour for midsize businesses. (Source: IDC.)

On-line Operation

Network/server UPS systems that use on-line operation and continuous double conversion provide the best protection and most reliable power available for critical systems. The double conversion process isolates equipment from power problems on the AC line and delivers ideal output 24x7.

Hot-Swappable Power Modules

Traditional UPS systems require you to power down and disconnect your equipment during a UPS repair. Before you can restore productivity, you'll need a repair technician to install the new UPS system and you'll need to reconnect, power up and test all your equipment. That process can require up to two hours of costly and inconvenient system downtime.

Some network/server UPS systems can eliminate system downtime during UPS maintenance and repair. They include one or more hot-swappable power modules and a detachable bypass PDU. You can completely remove and replace the power modules while the bypass PDU keeps your critical systems up and running without interruption.

Hot-Swap PDUs

Hot-swappable power modules are not usually found on UPS systems smaller than 5,000 VA, but you can make some smaller UPS systems ($\leq 3,000$ VA) hot-swappable by adding an external hot-swap PDU. The hot-swap PDU, also known as a bypass PDU, includes dual power inputs and a manual transfer switch. You can use the switch to select between UPS power and utility bypass power.

Power Redundancy

Many network/server UPS systems can be configured to provide redundant backup power, and some models have built-in redundancy. Models with two hot-swappable power modules automatically provide N+1 redundancy when the connected equipment load is $\leq 50\%$ of capacity. (The maximum load for N+1 redundancy is equal to the capacity remaining when one power module has been removed. That would be 66% for three power modules, 75% for four, 80% for five and so on.) If one of the power modules requires maintenance, repair or replacement, your equipment still receives conditioned power and battery backup. All the power modules can also be hot-swapped at once without interrupting equipment operation, which will be supported by the bypass power source.

You can provide full backup power redundancy to devices that have redundant power supplies by connecting each power supply to a separate UPS. Ideally, the UPS systems should also be connected to separate supply circuits and utility sources. For single-cord devices that do not have redundant power supplies, you can connect dual on-line UPS systems to a PDU that has an automatic transfer switch (ATS). The ATS PDU will switch to the secondary power source if the primary power source fails.

Wide Input Voltage Range

Network/server UPS systems that can correct a wide range of input voltages without switching to battery can reduce battery wear by as much as 40%. This reduces battery life-cycle costs and ensures that batteries are more likely to provide reliable service during outages.

Automatic Bypass

Network/server UPS systems with an automatic AC bypass route utility power to your equipment and keep it powered if the UPS experiences an extended overload or internal fault.

Hot-Swappable Batteries

All internal and external batteries of network/server UPS systems should be hot-swappable. You can replace hot-swappable batteries without powering down the UPS system or your equipment.

Overload Capacity

Some network/server UPS systems can handle overloads up to 150% for brief periods to support higher inrush currents at startup and fluctuating power demands during use. They can also transfer to bypass dynamically to sustain operation during higher and longer overloads for extended periods. This capability allows UPS systems to handle the repeated inrush spikes of heavy inductive loads without shutting down.

8 How can you save energy without compromising protection?

High-efficiency network/server UPS systems can save energy and help you reduce your power, cooling and infrastructure requirements, contributing to lower capital expenditures and operating costs.

UPS Efficiency

All UPS systems are less than 100% efficient because part of the electrical energy drawn by the UPS is converted to heat before it reaches your equipment. The heat also requires cooling systems to work harder, consuming an additional ½ watt of cooling for each watt of heat generated by the UPS.

Economy Mode Operation

Advanced on-line network/server UPS systems may support economy mode operation to save energy and reduce operating costs. While input power quality is good, the UPS operates with maximum efficiency. If input power quality worsens, the UPS uses double conversion to provide maximum protection. On-line UPS systems operating in economy mode can increase efficiency by as much 10% compared to traditional on-line UPS systems. For example, replacing 64 kilowatts of traditional on-line UPS systems with models that support economy mode operation can save more than \$10,000 per year in power costs while reducing your facility's energy usage and carbon footprint.

9 How often should you replace UPS batteries?

Battery Replacement

Network/server UPS system batteries typically last three to five years with normal use. The UPS should include a function for testing the batteries to ensure that they're ready to provide backup power during an outage. If the batteries fail the test, they may need to be replaced. Network/server UPS systems allow hot-swap replacement of internal and external batteries.

Replacing Batteries Versus Replacing the UPS

Replacing the batteries will allow the UPS system to remain in service, causing little or no disruption to its operation. Replacing the entire UPS system is usually more disruptive and expensive, but it will provide fresh batteries, fresh components and a new warranty. Replacing the UPS may also upgrade the UPS with higher efficiency, new features and capabilities that may not have been available when the original UPS system was purchased. Consider both options, weigh the value of new features versus the increased cost and disruption of UPS replacement and make your decision from there.

10 How will you manage the UPS system?

Network/server UPS systems include a variety of options for local and remote management. Whether you're standing in front of the server rack or thousands of miles away, you can monitor power conditions, receive automated alerts and take steps to troubleshoot and correct minor problems before they become major headaches.

Control Panel

Convenient front-panel controls report important power conditions such as load level and available runtime through LEDs and/or an LCD screen. UPS systems that include an LCD status screen can report more detailed information and provide better access to UPS settings and data at the rack level.

Remote Management Options

You may be able to connect the UPS system's built-in communication ports (USB and/or serial) to computers for local management or remote management by proxy. In most mission-critical applications, however, you will not manage UPS systems through host computers. Network management cards enable stand-alone remote management over the network without direct connection to a host computer. You may also be able to connect environmental sensors to monitor parameters such as temperature, humidity and contact closure inputs.

Centralized Management

Whether connected via host computer or network management card, network/server UPS systems should support centralized remote management through software provided by the manufacturer or a third-party vendor. Licensing fees for management software from some vendors can be very expensive if you need to support more than a few UPS systems, so make sure to consider this cost when you plan your budget.

Emergency Power Off

Network/server UPS systems typically include provisions for connecting to your facility's Emergency Power Off (EPO) circuit. During an emergency, activating the EPO switch will immediately de-energize all the equipment connected to the EPO circuit.

11 How can you reduce installation and maintenance costs?

Self-Service

Consider the cost of installing the UPS system, as well as ongoing service requirements. Some UPS manufacturers assume that the installation, maintenance and repair of UPS systems will be performed by outside technicians through service contracts, so you'll need to make sure you include the cost of those service contracts in the ongoing cost of the UPS. Other manufacturers design UPS systems so IT staff or even non-technical staff can perform most tasks in-house if you prefer. Self-service capability can reduce the UPS system's total cost of ownership (TCO) significantly.

3-Phase UPS Installation

If you are considering a 3-phase UPS system, consider units with low ($\leq 5\%$) input Total Harmonic Distortion (THDi). Low THDi saves money by reducing or eliminating the need to over-size generators, breakers and other input components.

12 Where can you find more UPS advice if you need it?

Making the Right Choice

As you build, expand or reassess your IT infrastructure, don't shortchange your backup power requirements. It's an area for potentially significant cost savings, and it's of extreme importance in ensuring uptime and system availability. Choosing the right network/server UPS system can be a complex task, especially since your organization may require different UPS systems for different applications.

Working with a Dependable Partner

One of the best ways to understand the various options for your organization is to leverage the experience of a dependable partner. Engage directly with a trusted manufacturer that offers UPS systems suitable for the various applications you're likely to encounter.

Tripp Lite manufactures a wide range of network/server UPS systems and provides free power audits and infrastructure assessments. A specialist will evaluate your power needs, identify potential problems and recommend cost-effective solutions.

Tripp Lite also provides various online resources to help you find the ideal network/server UPS system for your application:

- Detailed UPS specifications at www.tripplite.com/ups/
- Our interactive UPS selector at www.tripplite.com/upsfinder/
- Our Chicago-based support team at www.tripplite.com/support/

Ready for expert help right now?

Contact Tripp Lite's UPS application specialists directly at **773.869.1236** or upsapplications@tripplite.com.

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 data center solutions, visit www.tripplite.com.



Manufacturing
Excellence.