ZONIT®

Structured Solutions

ZONIT® POWER DISTRIBUTION SYSTEM

DEPLOYMENT GUIDE

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Introduction

The Zonit® Data Center Power Distribution System (zPDS™) offers an ultra-reliable, turnkey power distribution system for modern high-availability mission-critical data centers. It simplifies the distribution, management and monitoring of power distribution between data center Power Distribution Units (PDUs) and end-user racks, cages and servers. It enables quick and easy deployment and re-deployment of data center resources while eliminating the source of errors that result in downtime and unbalanced use of power phases.

This deployment guide describes the Zonit power distribution system, and offers recommended best-practices for how to specify and use it in the most typical configurations; Also covered is how to use it with the less common configurations.

The guide defines and describes the components of the power system of a modern data center. It then uses the example of a typical medium scale data center and guides the reader through a step-by-step methodology to plan the maximum power density of the facility and then determine how to specify and deploy the Zonit system. With several typical configurations as references, the benefits of the Zonit system approach are described in terms of the improved reliability, ease of data center deployments, balanced power loading, improved power management, safety, increased rack-mount density and other data center advantages that are achieved.

The Zonit system has many benefits. They are summarized below;

- Master planned end-to-end solution
  Plan once, Deploy whips once, add Zonit units and accessories when needed
- Change is accomplished above the floor without endangering power delivery
- Very high power capacity in a 2U unit, supports ultra-dense deployments
- Total reliability built-in w/ extremely high MTBF, UL Listed, 25 year warranty
- Provides full power redundancy via independent A-B power paths to equipment
- Automatically delivers electrical load balancing across multiple phases via patented design
- Reduces PDU size and cost by reducing whip and breaker count
- Maximizes underfloor airflow by minimizing whip count
- Avoids hard to diagnose and cure grounding and neutral power current problems
- Eliminates the need for ongoing master electrician time and expense
- Dramatically decreases scope of disruptions caused by equipment short circuits due to greater subdivision of power delivery
- Streamlines and facilitates adds, moves, changes and simplifies upgrades
- Eliminates traditional cord tangle

The Zonit power distribution system has been in the market over seven years and is used by organizations such as Level 3 Communications, Home Depot Corporation and Florida State University. Zonit® Structured Solutions is based in Boulder, Colorado and is a spin-off of the Root Group, Inc. a leading information technology integration company since 1989. Zonit® Structured Solutions, LLC. was created in 2007 to focus on the development of Zonit data center solutions and driving their adoption in the commercial, government and DoD markets.

Zonit System Background Information

The following background information is useful to understand the design framework that you will use when planning a Zonit system deployment. We have observed that the key factor for our clients to understand the usage of the Zonit system is grasping the “language” of the Zonit system. Once you have mastered this, solving new power requirements using the Zonit system becomes very easy.

Overview of the Zonit Design and Deployment Methodology

The following steps are a condensed overview of the methodology. They are covered in detail later in the document. The key point to note is that a maximum density target is chosen and a uniform grid of power whips is deployed based on that. The power whips can be run underfloor or overhead in cable raceways, as appropriate to your data center layout.

1. *Decide on target maximum density during Data Center lifetime. For enterprise data centers, this is the average power needed in each rack. In a co-location facility this is the maximum power available in any particular rack.*
2. *Deploy Uniform Grid of power whips to Zonit specifications matching density target*
3. *Determine Zonit system components that are needed for immediate deployment needs. Obtain and install.*
4. *Specify additional Zonit system components needed for each new deployment need. Obtain and install.*

The language of the Zonit system is comprised of the following basic elements.

1. *Uniform, A-B redundant power whips are deployed and available in the DC*
   The Zonit system will power over 95% of the commercially available data center equipment on the market today with available Zonit plugstrips and adaptors. There are custom adaptors for MilSpec and other applications. The rare exceptions that can not be powered from the Zonit system or directly from the uniform grid, will be handled by custom power whips, specific to that application requirement.

2. *Zonit components are ordered and deployed only as needed*
   You order Zonit components as new equipment needs to be deployed in your data center. Installing it is simple, plug Zonit units into the power whips, plug Zonit plugstrips and adaptors into the units and plug data center equipment into them.

3. *Adds, moves and changes happen within the Zonit system, by design*
   All changes in the Zonit system are designed to occur by plugging and unplugging standard power connections. If requirements in a particular rack change, they are accommodated by adding or changing the Zonit plugstrips or adaptors. The density of the data center increases, through new deployments. The only changes needed are to specify, order and deploy the required Zonit components. The only exception to this cycle is when the capacity of the data center core power and cooling infrastructure needs to be upgraded.

4. *The key benefits don't have to be engineered for each change, they are always there* Redundant power is always available, power phase loading is always balanced, power delivery is segmented and controllable. Regardless of the number of deployment changes you make in your data center, the Zonit system always delivers these important benefits to every piece of equipment in your data center.

The information in the remainder of this section lays out the feature set of the Zonit system in traditional electrical component terms, so that you will have this information available as you later go through the detailed steps of understanding how to design a Zonit power distribution system deployment for an example data center.

Each Zonit unit is a 2U high component with the breakers on the front of the unit and all connectors on the back. Each unit includes mounting brackets for standard NEMA 19 or 23" racks. Serrated washers are included in the mounting kits and should be used to insure proper metal-to-metal contact for proper grounding. The Zonit system insures that all grounds go back to common tested grounds on the PDU units preventing ground loops, a strong benefit.

The power whip grid is a uniform set of 30A three-phase wye-configured feed pairs from A-B power sources. The neutral conductor is upsized one gauge in all whips. Each Zonit unit offers four 208V 20A primary power feeds from L-21-20R receptacles and an additional six single-phase 120v 15A power feeds from standard NEMA 5-15R receptacles. All of the receptacles are evenly divided between the A and B power feeds so equal numbers of redundant power outlets are available.

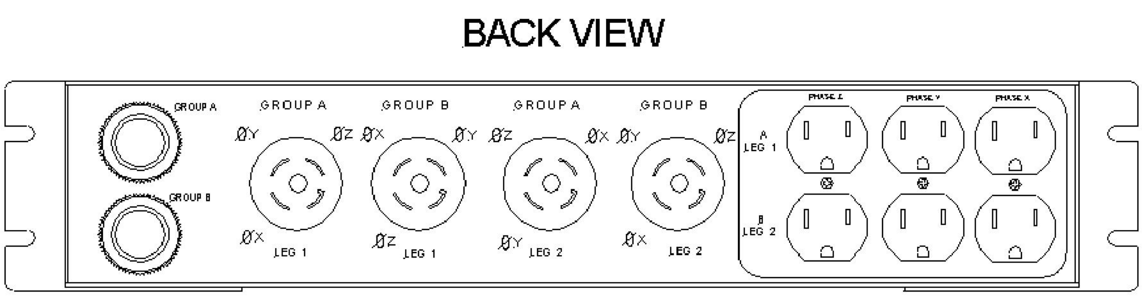

Figure 1 – Zonit Main Unit - Back View

The following Zonit system plugstrips are offered:

- ✧ A 120v, 20A (3x) with 20 NEMA 5-20-T receptacles per plugstrip.
- ✧ A 208v, 10A (3x) plugstrip with 20 NEMA 6-20R receptacles.
- ✧ Other vendors (APC, Liebert, others) make 3 phase, 20A plugstrips with a variety of receptacle types (NEMA 5-20-T, IEC C14, IEC C19, etc.). These plugstrips have a TCP/IP Ethernet interface that allows remote power quality monitoring and/or control (switch on/off) of receptacles via a Web browser. These plugstrips can be ordered with NEMA L21-20P plugs that will work with the Zonit unit.

An important point to understand in your power capacity planning and equipment organization in each rack is how the Zonit plugstrips organize and deliver their power. The 120v single-phase 20A plugstrip (most common) consists of 20 receptacles. The receptacles are organized into "color groups" using one of three colors: black, white or cream. Each plugstrip receptacle group of the same color is fed by one phase of the L-21-20R three-phase 20A main unit receptacle and can deliver 20A. Also, each color group of receptacles is on a separate 20A circuit breaker located on the front of the Zonit unit. So, when planning on how to populate a rack, you can use the color-coding to recognize that all of the equipment plugged into one color of receptacle cannot exceed 20A. This makes power planning and inventories easier. It also minimizes the effects of a short-circuit, which affects fewer outlets.

Note: The 120v 40 receptacle plugstrip is essentially double the number of receptacles but each receptacle color group is still limited to 20A. This plugstrip is intended for situations where large numbers of devices need to be connected without an increase in power density.

The 208v split-phase 10A plugstrip consists of 20 receptacles organized into “color groups” of one of three colors: black, white or red. Each receptacle group of the same color is fed by two phases (XY, XZ or YZ) of the L-21-20R three-phase 20A receptacle, and can deliver 10A each. So, just like the 120v plugstrip, when planning on how to populate a rack, you can use the color-coding to recognize that all of the equipment plugged into one color of receptacle cannot exceed 10A at 208V.

You can also use the color grouping to decide to separate equipment onto different distribution circuits, (but not different power feeds, for that you need to plug into two different plugstrips or adaptors), just make sure they are plugged into different color receptacles. This can help insure uptime. This is a unique advantage of the Zonit system.

The following Zonit system accessories are offered. Adaptors are available to supply equipment specific receptacles of any standard configuration with 20A from Zonit units in single phase, split-single phase, or three-phase configurations in either 120V or 208V. Applications that require 30A are supported by connecting directly to the Zonit 30A three-phase power whip grid. The receptacle types below are available. Additionally, numerous Russel-Stol, straight blade, MIL Circular, and international accessories can be ordered, ask your sales representative for details.

- **NEMA 5-15**
- **NEMA 6-20**
- **NEMA L5-15**
- **NEMA L6-15**
- **NEMA L14-20**
- **NEMA L14-30 ***
- **NEMA L15-20**
- **NEMA L15-30 ***
- **NEMA L21-20**
- **NEMA L21-30 ***

** Indicates adaptor does not need a Zonit unit and plugs directly into 30 amp Zonit power whip feed grid.*

Note: Zonit plugstrips and power accessories have unique wiring specifications and other features that are designed to work with the Zonit units to properly distribute power, balance three-phase power loads and have greater circuit granularity (limiting the number of receptacles that are affected by a short circuit or other overload condition). All of the Zonit components are designed to work together as a system and guarantee maximum reliability and functionality.

Typical Data Center Design

The intent of this section of the guide is to go through the design cycle of the power system of a medium scale data center from start to finish. This is important so that every reader has a standard reference model, understands all of the steps that are needed, and how and when the Zonit system fits in the design cycle.

Major Elements of Data Center Power Systems

Figure 2 below shows the major elements of most typical data center power systems. The major components are defined here.

- **Utility Grid** – Industrial power feed from a utility company. Standard practice is to get feeds from separate grids (different distribution sub-stations) if possible.
- **Local Generator** – A backup electrical generator that is brought online in the event of an extended utility company power outage. Typically diesel or natural gas powered. Very high reliability sites have multiple backup generators for redundancy and reliability.
- **Transfer switch** – A switch between the various sources of electrical power.
- **Uninterruptible Power Supply (UPS)** – A power component that usually includes integrated batteries for instantaneous failover, if line or generator power fail. The UPS also filters and regenerates (via a transformer) the line power so that it is very clean and suitable for data processing equipment. In very large data centers, the batteries are not integrated into the UPS, but instead are put into a separate room with a controlled environment and acid-spill retention features. High reliability datacenters usually have a pair of matched capacity UPS units to insure two completely independent power sources are available to distribute redundant A-B power whips to the racks.
- **Power Distribution Unit (PDU)** – A cabinet (or cabinets) consisting of a power bus and slots for holding power breakers that connect to the power bus. Each breaker is used to power one power whip. In small to medium data centers, PDU's are mounted on the wall, in large to very large data centers, they are free-standing units on the floor that look like small refrigerators.
- **Auto-Transfer Switch (ATS)** – A switch that automatically switches between A-B input power sources in the event of a power failure.
- **Power whip** – An industrial class extension cord, hard-wired at the source end. The end may have multiple power receptacles, depending on type.

  Note: The traditional image of data centers is of a room with a raised floor. While this is very common, there are many data centers that do not use raised floors, instead they use overhead horizontal wire ladder-style raceways to distribute power and data cabling. This document primarily discusses the raised floor type of data center, but the Zonit system works equally well in non-raised floor cable raceway type data centers.

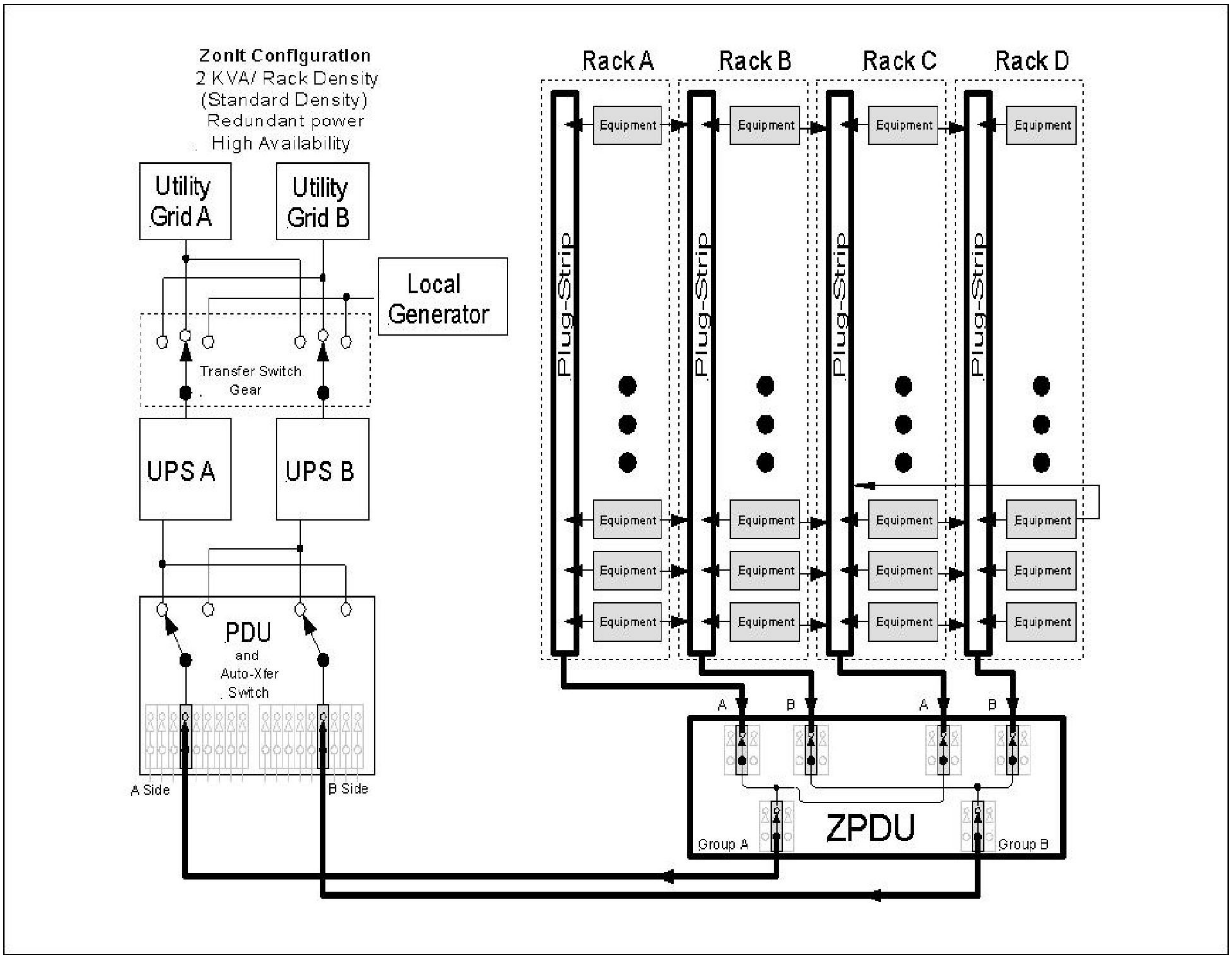

Figure 2 – Data Center Power Infrastructure

Data Center Power System Design Phases

A typical data has the following steps in the design and implementation of the power system.

1. *Specification and Design of the Core Power Infrastructure*

   The core power infrastructure consists of the utility power grid feeds, transfer switch(es), backup power generator(s), UPS units and PDU units. The UPS battery modules tend to be integrated into the UPS units in medium size units. In very large data centers the battery modules are often housed in a separate room with acid containment capabilities. The core infrastructure is designed by the architect and industrial electrical engineer to capacity limits that they heuristically derive from prior experience, or design constraints that they are given. The example in Figure 1 shows the core power infrastructure with a simple traditional power distribution system of 20 amp single phase whips. An alternate design that is more cost effective would be to only have one UPS unit and make the other power source 208V three-phase AC, which is easily stepped down and conditioned from standard utility 480v three phase AC.

The traditional capacity guidelines that most data center industrial engineers use are fairly low. A dense-pack data center that is approaching the usual cooling limit of air in a standard configuration data center (without special air handling arrangements or other cooling technologies such as in-rack cooling) will require power delivery capacity of approximately 9000 watts per rack w/ cooling to match. This is about 300 watts per square foot of data center floor space after accounting for needed adjustment factors. Most data centers are designed with power and cooling capacities that are less than this density. Cooling is the limiting factor in achieving maximum deployment density. The primary factors that must be correctly designed are all those that affect cooling airflow in the data center. This includes: location of CRAC units, raised floor height, pressurization gradient, rack locations, underfloor cable and plenum management and the location of any needed auxiliary airflow devices to avoid "hot spots" forming in the data center. Depending on the exact circumstances it is approximately twice as expensive to expand a data center as it is to dense pack it, even when extensive upgrades to the core infrastructure are needed.

As a capacity planning exercise, for a 10,000 square foot data center, we can do the following analysis. At maximum power density, approximately 50% of the floor space of the data center will be available for racks, after accounting for all other needed equipment (UPS, HVAC, PDU(s), etc.) and required aisle space. A medium density data center can raise this factor to 66% due to the fact that the core infrastructure will have less capacity and therefore consume less floor space. The limit in this heuristic is getting the HVAC to remove the heat, not the delivery of power. Each rack will consume an average of 16 sq. feet of data center floor space.

From this example we can calculate that data center of 10,000 square feet size would support approximately the following numbers of racks and require the calculated number of Zonit units and power whips.

a) <u>Maximum power density case</u>
10,000 sq. ft of DC floor space x 50% = 5,000 sq. feet of rack space
5,000 sq. ft of DC rack space ÷ 16 sq. feet per rack = 312 racks
1 Zonit unit per rack = 312 units
2 A-B 208v, three-phase power whips per Zonit unit = 624 whips

b) <u>Medium power density case</u>
10,000 sq. ft of DC floor space x 66% = 6,666 sq. feet of rack space
6,666 sq. ft of DC rack space ÷ 16 sq. feet per rack = 420 racks
1 Zonit unit per pair of racks = 210 units
2 A-B 208v, three-phase power whips per Zonit unit = 420 whips

Using these numbers, we can determine the core infrastructure capacity requirements.

a) <u>Maximum power density case</u>
312 racks x 9,000 VA per rack = 2808 KVA of UPS capacity
2808 KVA of power = ~796 Tons of cooling capacity needed

b) Medium power density case
420 racks x 4,500 VA per rack = 1890 KVA of UPS capacity
1890 KVA of power = ~536 Tons of cooling capacity needed

In actual practice, most core infrastructure capacity is upgraded in phases, as the need grows. The capacity guidelines developed in this section can be very useful for data center architects, industrial designers and managers to cooperate on long-term capacity goal planning, to insure that the data center can be easily upgraded to reach the desired target densities during its lifetime. Floor space can be chosen and reserved for additional core infrastructure components and the most difficult and expensive to upgrade elements, for example, cooling towers and diesel fuel tanks, can be sized appropriately from the start.

2. *Implementation of the Core Power Infrastructure*

The data center is constructed, the floor is laid (if raised floor is used), the fire suppression systems installed and the core power system components are installed and tested. The data center cooling system components are also installed and tested at this time. This insures the power and cooling core components perform to specification and are correctly installed. At the end of this phase, the data center is ready to begin the process of installing end-user equipment on the floor. An example 2000 sq. ft. data center that is in this state is shown below in Figure 3.

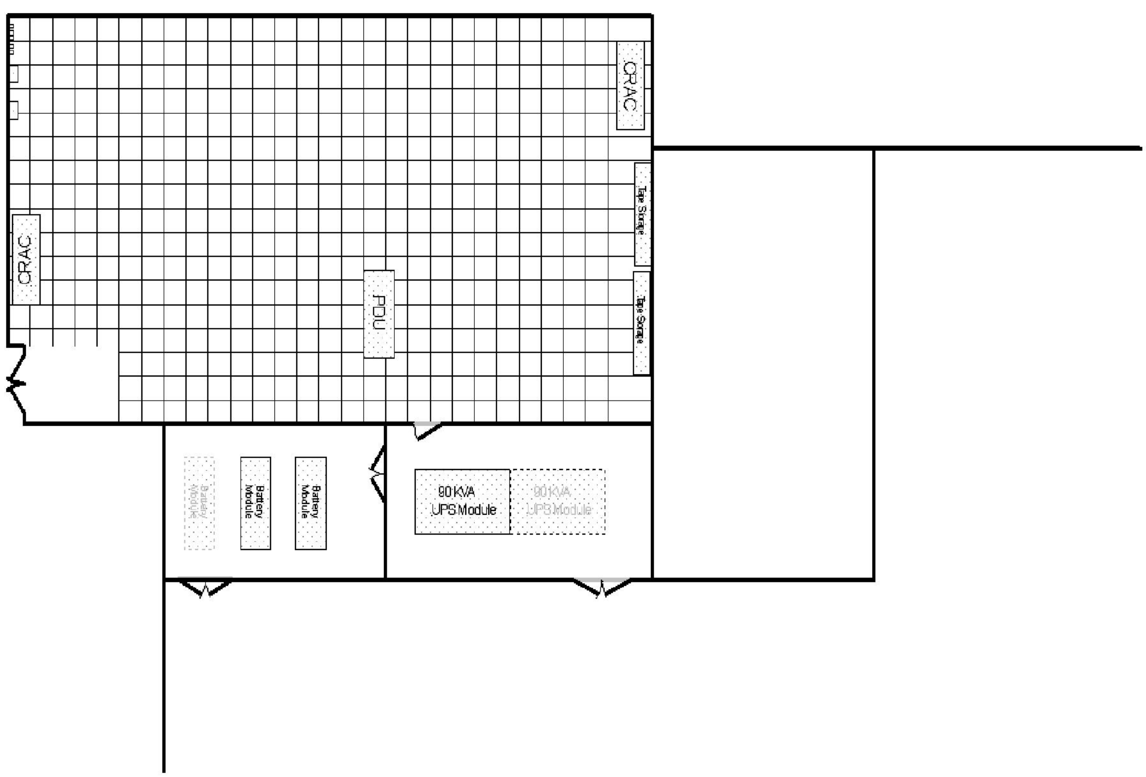

Figure 3 – Data Center with Core Infrastructure, Not Populated

3. *Specification and Design of the Data Center Power Distribution System*

This is the point at which the traditional way of populating data centers and the Zonit system diverge. In the traditional way, the data center manager locates the racks on the floor and then has a master electrician run power whips from the PDU to the rack, with the chosen capacity and receptacle type. A power distribution strip or strips are installed in the rack and plugged into the power whips. The end-user equipment is then plugged into the system. The master electrician must then also balance the power phases, if the UPS systems are multi-phase, not single phase. This cycle is repeated for each rack or equipment cabinet and incrementally for each move, add and change to the power distribution system during the lifetime of the data center. Each time this cycle is executed the chance is taken that errors can be made that will affect the reliability and stability of the power distribution system.

The Zonit system methodology is different. It takes a master planned approach and this allows a turnkey solution to be designed and deployed. The methodology is shown below, step-by-step.

<u>Core Power Infrastructure Assumptions</u>
The Zonit system delivers one of the highest power capacities in the industry. This enables very dense packed data centers, insuring that the investment in the data center core power and cooling infrastructure is leveraged to the maximum. This insures optimum efficiency and return on investment. The Zonit system assumes that the following capabilities are available from the UPS components of the core power infrastructure.

- Redundant A-B, three-phase 208v power feeds, wye-configured.

<u>Power Distribution Design & Deployment</u>

1. *Choose data center maximum deployment density.*
   Air cooling is becomes more difficult at a capacity of approximately 9kVA (9000 watts) per rack. This capacity can be raised but it usually requires investment in special cooling arrangements. The Zonit system is designed to support up to and beyond this power density (for data centers with special cooling systems that go beyond standard optimized HVAC). A target density is chosen by the client based on known or projected needs of the data center **during its entire lifetime**. Zonit has developed a set of planning guidelines for this based on data center projects they have researched and participated in.

   Data center equipment has differing power density requirements. Host computers especially those with multiple CPU's consume the most power, networking equipment tends to have high power consumption, data storage arrays consume less, and tape libraries often the least. The problem in trying to optimize whip density to a given deployment configuration is predicting change over time. It is difficult to forecast what mix and location of equipment will be needed at any given point in time over the life of the data center. This is especially true given the difficulty of shutting down production equipment to re-organize the data center and the fact that some equipment must be located close to other equipment due to cabling limitations. Zonit has observed that a better design practice is to assume a uniform power density and deploy a uniform grid of power whips. This gives maximum flexibility at a negligible increase in cost.

Rather than do a complete power inventory and then determine which equipment sits in which racks, a much simpler method is available. Most data centers are conventional and will require medium density levels. A lesser number will fall between the maximum and medium density cases. Only a few will be less dense. Numerous factors can be involved in this decision. The most prominent will be the ability to cool the space. This is the physical limit for calculating the actual maximum power capacity. Assuming the cooling capacity is adequate or can be upgraded to the required capacity, a simple metric to use for planning this is the optimum Zonit density. The optimum will be a balance between the maximum density your data center can reach without any unusual redesign costs and what you can accurately project as your real growth needs. Remember that it is almost always cheaper to dense pack a data center than it is to expand it, so erring on the high side of a density target is usually less expensive over the long-haul.

The goal in this step is to decide the target maximum density in the data center's lifecycle, not at initial build-out. A simple metric to use to plan this is the required Zonit unit density. To support maximum density, one rack per Zonit unit is used, medium density requires one Zonit unit per each two racks and low density requires one Zonit unit per four racks.

Let's review the factors from the heuristic we developed earlier in calculating the capacity requirements of our example 10,000 sq. ft. DC.

- Maximum density has 50% of the floor space for racks
- Medium density and lower has 66% of the floor space for racks
- Each rack takes up ~16 sq. ft. after accounting for aisles, etc.
- Each Zonit unit requires 1 pair of A-B 208V three-phase whips

Using our algorithm we can calculate that data center of 10,000 square feet size would support approximately the following numbers of racks and require the calculated number of Zonit units and power whips.

a. <u>Maximum power density calculation</u>
10,000 sq. ft of DC floor space x 50% = 5,000 sq. ft. of floor space available for racks.
5,000 sq. ft of DC rack space ÷ 16 sq. feet per rack = 312 racks
1 Zonit unit per rack = 312 units
2 A-B 208v, three-phase power whips per Zonit unit = 624 whips

b. <u>Medium power density calculation</u>
10,000 sq. ft of DC floor space x 66% = 6,666 sq. ft. of floor space available for racks.
6,666 sq. ft of DC rack space ÷ 16 sq. feet per rack = 420 racks
1 Zonit unit per each 2 racks = 210 units
2 A-B 208v, three-phase power whips per Zonit unit = 420 whips

To finish this step the data center manager must choose the final projected density for the data center. Zonit has seen that almost every data center has experienced significant equipment count growth during its lifetime. We therefore recommend that a maximum density choice be made. This is not a difficult choice, since the only additional expense is laying more power whips. Also, it is much less expensive and risky to do one deployment of the power whips under the floor and never have to disturb it again. Zonit units and accessories are only purchased as you need them. The only exception we have seen to this rule are in data centers that can not have their core power and cooling infrastructure upgraded for some reason.

2. *Deploy the uniform grid containing all needed whips at one time*
The Zonit system enables the design, planning and deployment of the power whip grid at one point in time. This offers the data center manager the opportunity to contract for this work at advantageous rates and if this is a redeployment, to do any needed cleanup of legacy cabling. It also makes it much easier to insure that the work is done properly and is completely tested and documented. This is a great advantage in insuring reliability.
The whips are deployed once, in a grid under the raised floor (or in overhead wireways in non-raised floor data centers, the Zonit use of twistlock receptacles makes this easy), tested and then left alone. Each terminates in one L21-30 twistlock receptacle.

There are a couple of choices in deciding how to deploy the uniform power grid. If appropriate existing conduit is available, it can be used or reused. If new conduit is deployed, then there are two methods to choose between.

The most typical practice is to run one conduit for each power whip deployed. This insures the maximum flexibility later, if a power whip needed to be moved. However, the Zonit system eliminates the need to move power whips, since the receptacle grid is uniform and available everywhere in the data center. Therefore, we have developed a deployment method called the Zonit multi-whip methodology. In this method, the wires for multiple receptacles are run thorough the same conduit, usually of 2-2.5” diameter, depending on local code. Each receptacle is located in a 4”x 4”x 8” receptacle box that has sufficient room to route the wires that go to other receptacles farther down the conduit. To insure redundancy and minimize the effects of damage to a single conduit, the best practice recommendation is to route all of the wiring as shown below in Figure 4. This insures that each Zonit is fed by two separate power paths. The maximum density case is shown in Figure 4 with two power receptacles feeding a Zonit ZPDU-2 unit in each rack. The medium density case would place the receptacles under every other rack, feeding a total of 8 racks and the low density case would place the receptacles under every fourth rack, feeding a total of 16 racks.

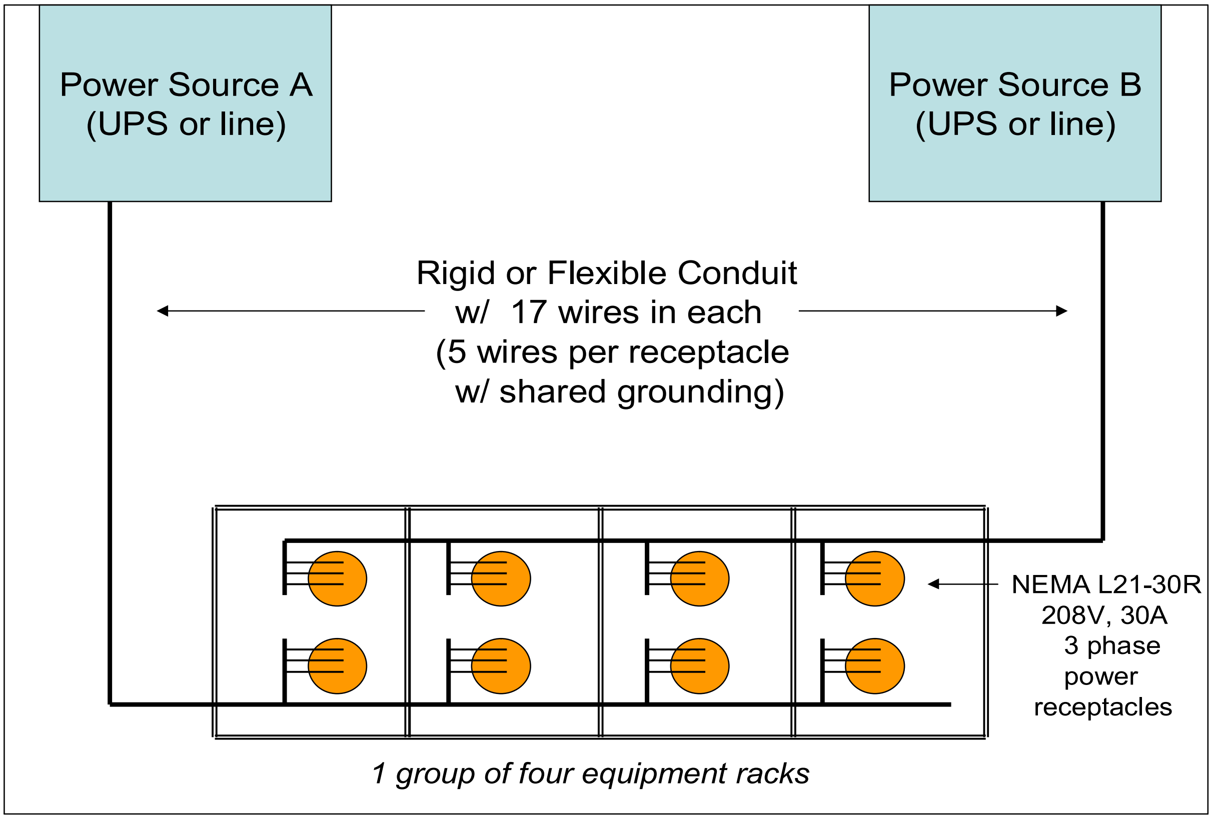

Figure 4 - Zonit Power Whip Deployment Details,
Maximum Power Density (9KVA/Rack)

The use of this practice can cut the number of conduits used by up to ***16 times*** vs. the traditional methodology 20A single phase method and four times vs. running each Zonit power whip in a separate conduit. This is a large cost savings and also can greatly increase airflow under the raised floor by reducing the number of power conduits.

All of the whips will be the same, 30 amp, three phase, 208v. One A-B pair (one whip from UPS A, one from UPS B) is needed to power each projected Zonit unit. We recommend that the power whips be run from the PDU, they be carefully tested and certified for production and then only the ones that are initially needed be powered up by engaging their breaker in the PDU. The others should be left with their breakers in the off position.

Note: It is <u>very strongly recommended</u> that the power whip connections be certified for proper tightness after installation by the use of calibrated torque wrenches to insure that each wiring post of each breaker or connector is tightened to the correct value. This eliminates a major source of long-term problems in power whip deployments. This step should be insisted on and all torque values recorded to insure no posts are missed. If done right, the connections will function properly for the life of the data center. If done inconsistently, they can be a major headache to troubleshoot and correct.

The routing of the power whip grid should be done to minimize cooling airflow disruption and the whips and their outlet receptacles should be clearly labeled and coordinated to the labeling of their associated PDU circuit breakers.

3. *Determine how many and what type of Zonit units and accessories are needed to populate the data center*

   The Zonit system is designed to power mission critical data center configurations of many types. The issues below should be considered when determining what types of Zonit units and accessories to specify. The Zonit System Users Manual has more detail on this topic and should be read for more background information.

   The power requirements for each type of equipment can be classified based on the criteria below.

   a. Power need – Voltage and amperage
      - ⊕ 120V single phase @ 20A max
      - ⊕ 208v single phase @ 20A max
      - ⊕ 208v split single phase (2 120v circuits) @ 20A max
      - ⊕ 208v 3 phase @ 20A max
      - ⊕ 208v 3 phase @ 30A max
      - ⊕ Other

   b. Receptacle type – The Zonit system supports the following standard NEMA receptacle types via plugstrips or adaptors: NEMA-5-15, NEMA-5-20, NEMA-5-20-T, NEMA-L-5-15, L-5-20, L-6-15, L-6-20, L-14-20, L-21-20.

      Note: Four L-21-20R receptacles are available for direct connect.
      Note 2: Custom adaptors are available for other receptacle combinations as long as current capacity is within circuit limitation.

   c. Redundancy need – There are four types of redundancy configurations.

      i. Dual Independent – This configuration is for equipment with dual power supplies. They are fed by two separate cords each of which will be connected to the separate A-B power sources.

ii. N+1 Independent – This configuration is for equipment with N+1 power supplies. They can be fed by a separate cord for each power supply or 2 power cords for the component or other means. An N+1 configuration often needs an optional auto-switch that is used to insure that N power supplies will always have adequate power from either of the separate A-B power sources, if either A or B goes down. Contact your sales representative for recommended auto-switch options.

iii. Single cord, A-B auto-switched - This is for equipment with a single power supply cord which need maximum uptime. The power cord is connected by an auto-switched receptacle that is connected to both the A and B power sources. The auto-switch automatically switches the power feed from A to B (or B to A, depending on configuration) in the event that either of the power sources goes offline.

iv. Single cord, no redundancy – This is for equipment with a single power supply cord that does not need maximum uptime. The power cord is draws from one of the A or the B power sources depending on how it is connected.

Now that we have identified the requirements for the equipment in the data center as regards voltage, current capacity, receptacle type and redundancy need, we can easily identify how it will be powered.

- Standard configuration - Will be powered by Zonit plugstrips. or accessory outlets w/ autoswitch capabilities added as needed. Over 95% of the equipment in the data center will fall into this category.

- Rare configuration - Will be powered by Zonit power adaptor(s) w/ autoswitch capabilities added as needed.

  Note: In the few cases where more than 20A three-phase is needed, the adaptor will plug into the Zonit 30A power whip directly. No Zonit unit will be used in this configuration. Since all three phases are drawn on equally in this case the phase load balance is preserved.

- High Power custom configuration – This is for the very few devices that need more than 30A three-phase power. They will be powered by custom specification power whip(s) run directly from the PDU. This requirement is very rare in modern data centers, but a few types of equipment still exist that need this.

- DC Powered units – The Zonit system can be used with high reliability AC to DC rectifier units to supply standard 48V DC power. Redundancy can be delivered by using two rectifiers, one on the A power source, the other on the B power source and bridging the outputs together to insure that two independent power sources are available to DC powered equipment. This method of DC power delivery has the great advantage of leveraging the high-reliability UPS units and not requiring a separate power delivery system dedicated to DC power. The Zonit system delivers the required redundant power and it is converted to DC at the rack locations in the data center where it is required. This also is more efficient, as DC power transmission efficiency declines quickly with distance.

Note: We have extensive experience with the selection of appropriate DC rectifiers for use with the Zonit system. Contact your Zonit sales representative if you need options for this type of configuration.

The Zonit system deployment design problem now breaks down into organizing the equipment in the data center by power type, capacity total, then redundancy need. The other point to note is to pay attention to rotating the plugin order of powerstrips and accessories (by carefully following the installation guide directions) so that A-sourced power is always followed by B-sourced power and so on. This insures that independently sourced, redundant power is always conveniently located nearby in the low, medium and high-density Zonit configurations.

To determine what is needed, perform the following steps:

1st. *Equipment Location*

First decide what equipment will go in the rack(s) that the Zonit unit will be powering. For maximum efficiency, group equipment first by power type then by capacity need, then redundancy requirement, as much as is possible. An example would be to place a set of servers that required 120V @ 20A max power, needed NEMA 5-20R receptacles and could not draw more than a total of 20A each and 180A collectively. Each server has dual power supplies and needs to be redundantly powered.

2nd. *Identify all unusual power type requirements*

Each one of these will either require a Zonit accessory connector or be connected directly to the 30A power whip grid, perhaps with an adaptor, or in very unusual cases require a special power whip type run from the PDU. These are rare exceptions.

3rd. *Add up the numbers of Zonit units, plugstrips and power connection accessories needed.*

Based on a simple count of how many racks and cabinets will be deployed into the data center determine how many Zonit units need to be immediately ordered. Based on a count of the number and type of power outlets needed for each rack select the appropriate Zonit plugstrips (counting accessory outlets, if you choose to allocate them) and determine their total count for ordering.

4th. *Check your work by checking the power capacity totals per rack and number of allocated Zonit unit L21-20R primary receptacles.*

Verify your work by making sure that you have not over-allocated the number of L21-20R receptacles. This is the most common ordering mistake that we observe. Remember that the majority of Zonit power adaptors plug into these receptacles and each requires one vacant receptacle. Also remember that you can deploy a maximum of 180A per Zonit main unit in the rack, which is well beyond what most data centers can cool without special equipment!

4. *Deploy Zonit units as needed to populate the data center*
   Each Zonit unit can be purchased and deployed when needed. To install a Zonit unit is simple, the Zonit unit is typically installed in the bottom of the rack, paying careful attention to proper grounding procedures (essentially insuring that good metal-to-metal contact is achieved by using the serrated washers in the mounting kit) as detailed in the installation guide, the raised floor is opened and the two L20-5 male connectors are inserted and twist-locked into the pre-deployed whips. No electrician is needed. Since the Zonit main power feed cords are delivered with twist-lock connectors, use of overhead down facing receptacles is very suitable. This configuration is especially clean in installations where overhead wireway cable routing is utilized, or where raised floor access is limited or not desirable.

5. *Deploy needed Zonit plugstrips and adaptors as needed.*
   The Zonit system includes plugstrips and adaptors to accommodate most common types of power supply cords utilized by modern data processing equipment. The appropriate plugstrips and adaptors as ordered are plugged into the Zonit unit. The Zonit plugstrips mount easily in the great majority of modern rack cabinets, see the installation guide for details and recommendations. The data processing equipment is then plugged in to the plugstrips and adaptors following a simple pre-defined sequence described in the Zonit installation manual. The Zonit system will automatically deliver redundant power and statistically balance the load between the power phases, by its patented design. No other work is needed.

6. *Redeployments are simple*
   Moves, adds and changes only require changing the Zonit plugstrips and adaptors. Occasionally, Zonit units are moved or added to increase or decrease power density in a section of the data center. All changes occur above the raised floor. The only activity under the floor is the plugging in and occasional unplugging of Zonit units, to the previously deployed power whips with their uniform L21 locking receptacles. No new power whips are ever needed and none are cut off and abandoned. The PDU and underfloor environment is not disturbed.

The power distribution system remains reliable since all changes are confined to the Zonit system, which is designed to accommodate them via simple receptacle connection changes. The receptacles are rated to thousands of insertion and removal cycles, far beyond the change rate of any data center. All changes are accomplished within the Zonit system and do not affect the other elements of the power distribution system, by design.

Deploying the Zonit System Incrementally

The example just developed used a new data center, to clearly show the how to design and deploy the Zonit power distribution system, without any complicating considerations.

However, most data centers are not at the beginning of their lifecycle, rather they are somewhere in the middle of it. To plan an incremental deployment of the Zonit system, you will follow the same basic steps as in planning for a new data center, with some changes to accommodate the fact that the data center is already fully or partially occupied. If you are considering a UPS upgrade project, this is an excellent point in the data center lifecycle to upgrade the data center power distribution system to Zonit.

Planning Steps
The tasks below are the steps that are needed.

1. *Determine Data Center Maximum Target Density*
   This is an important step to do, even in a facility with existing equipment. It will help you set your goals by reviewing the current capacity issues in your facility and considering what you would want or need to change. The methodology used is to examine your current cooling and UPS capacity, consider your future needs and choose a target density. This is done in the same way as described earlier. Remember that to get the maximum benefit from the Zonit system, your power distribution system should over time be completely converted to it. Setting a long-term maximum density goal will help you do this.

2. *Choose Deployment Zone(s)*
   You may be deploying Zonit units to replace power distribution in populated racks or you may be deploying to parts of the data center that were not previously populated or have been cleared out. It is easiest to minimize underfloor work if you are able to pick a contiguous geographic area in the data center, for the Zonit upgrade.

3. *Decide on Zonit Whip Grid Strategy*
   If you will be upgrading the entire data center to use the Zonit system, you may wish to consider laying out the entire set of Zonit power whips at one time, but not connecting them to the PDU until needed. The upside to this approach is that you do the underfloor work at one point in time making it easier to contract and manage. You can also do any cleanup of legacy or abandoned wiring at this point. The only downside is that the Zonit power whips will eat up some of your underfloor plenum space. If you have marginal airflow due to cable clutter or a low floor height, you may need to incrementally deploy each Zonit whip as you remove the legacy whips, to maximize airflow.

4. *Manage PDU Breaker Slot Availability*
   One key difference in the incremental approach is that you must consider the availability of PDU breaker slots. Each Zonit unit requires a pair of 208V three-phase power whips, so in each one of the PDU units (A or B), three breaker slots (for a three-phase breaker) must be available. The Zonit system uses less breakers than traditional methodologies, but you must manage the available slots and insure enough are available as you do the upgrade.

5. *Check Power Phase Balance before Zonit deployment*
   The Zonit system balances the three-phase power loads as more circuits are added. Adding it to the UPS will preserve whatever balance that exists before you add Zonit. Check your power phase balance to make sure it is correct before you add the Zonit units. You will also have to re-check the power phase balance each time you make a change to the legacy power distribution areas of the data center, until you can upgrade them to the Zonit system.

Conclusion

The Zonit® power distribution system gives data center managers the ability to take control of an area that traditionally experiences high change rates and therefore is susceptible to errors and consequent production stability issues. A data center equipped with the Zonit system is much easier to use and change. Once you have made the effort to grasp the “language” of Zonit, eg. how to use the features and options of the system to meet your immediate problem, solving new deployment or move power issues becomes trivial and you reap the ongoing benefits of the system through every phase of the data center lifecycle. The power distribution system stays organized, stable and delivers all of the benefits that were present the day you installed it.

info@zonit.com
http://www.zonit.com
720-266-0050