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Faster – better – everywhere.

Whitepaper Rittal PDU international

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Executive summary

Companies are increasingly using intelligent power distribution units (PDU) instead of simple multiple sockets in racks with network and server equipment. PDUs can measure the distributed electrical parameters, switch loads, and identify environmental factors such as temperature and humidity. They allow a detailed view of the conditions inside the rack, and give administrators and data centre operators the information needed so that they can find quickly faults, implement energy efficiency measures, and discover potentials for use.

When selecting PDUs, many parameters are important, ranging from the mechanical properties on the load capacity and switching capacity of the devices to redundant functions and accuracy. The integration into a higher-level management framework should also be considered and planned, as should the protection of the data and the switching functions from unauthorized access.

Data centres often contain hardware and software worth hundreds of thousands of Euros. The operating costs for power and cooling, for example, can often reach tens of thousands of Euro a year, as numerous studies and practice examples have shown[1],[2]. With the aid of PDUs, these costs can be monitored and assigned to those who cause them. Furthermore, the newly gained control and the increased amount of data help in managing the hardware and on-site troubleshooting. Relevant components can be found more quickly, applications can be clearly assigned to a host, and so mistakes can be largely avoided when connecting and disconnecting.

Rittal's range of PDU products consists of the Basic, Metered, Switched and Managed models. It provides a continuous system solution, from power distribution to complex analysis functions. The functions of the PDUs are based upon and complement each other. Basic has a pure distribution function, Metered measures the overall consumption data, and Switched can also switch individual sockets. Managed also provides additional electrical data from each individual socket.

[1] Fichter, K. (2007): Zukunftsmarkt energieeffiziente Rechenzentren. Studie im Auftrag des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit. http://www.borderstep.de/details.php?menue=22&subid=24&projektid=260&le=de

[2] Energieeffiziente Rechenzentren: Best-Practice-Beispiele aus Europa, USA und Asien. http://www.bmub.bund.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/broschuere_rechenzentren_bf.pdf

Introduction

Power distribution units (PDUs) measure numerous electrical parameters, the built-in sockets can be switched on and off independently, and they can be remotely operated and monitored via network interfaces. Nowadays, just about every user can afford a powerful PDU. And they are becoming increasingly important because the pressure on the operators of data centres and server rooms to reduce energy consumption is increasing all the time.

According to an investigation by the Borderstep Institute[3], the power consumption of data centres in Germany rose from four to ten terawatt-hours (TWh) between 2000 and 2008. The curve has flattened off following the beginning of the Green Energy discussion in 2007. In 2012, only 9.4 TWh was consumed. But the savings were mainly made in infrastructure, such as climate control and UPS systems. The energy consumption of servers is increasing, as before.

Since 2013, Germany’s Federal Government has only been granting the tax cap (EEG levy) in the context of the energy and electricity tax if companies contribute to energy savings. Data must be provided as proof of energy reductions, e.g., on how power consumption has changed during the optimization period. PDUs are perfect for this, as they provide exact current consumption values for the individual phases, installation areas, server enclosures, even down to server level. This way, inefficient systems can be detected and countermeasures initiated.

The turn-around in energy policy, electromobility, and numerous sustainable power generation projects are all evidence of a constantly growing interest in electrical energy. Users want to control and optimize consumption and efficiency. With PDUs, this information can be recorded right down to the socket level. No data centre will be able to do without it in future.

[3] Hintemann, R., und Fichter, K. (2013): Server und Rechenzentren in Deutschland im Jahr 2012. http://www.borderstep.de/details.php?menue=33&subid=101&le=de#

Basic structure of a PDU

Viewed from outside, most basic PDUs appear similar to the classic socket strip. The input is a cable with a CEE plug, and consumers can be connected at a number of outlets. More powerful models not only distribute one phase; instead, they distribute three phases or are capable of passing on redundant input voltage circuits to consumers. Better equipped models record operating parameters such as the input voltage, frequency, and utilization of the phases. This way, administrators are provided with an overview of the quality of supply at the input of the rack.

Figure 1: Flexible connection options with Rittal PDUs.

Rittal's PDU range includes four basic types: the Basic, Metered, Switched and Managed models. Their functions are built upon each other. "Basic" has a pure distribution function, without any intelligence. "Metered" measures the total consumption data at the input of the PDU, while "Switched" can also switch individual sockets on and off. Furthermore, "Managed" provides additional electrical data from each individual socket. In addition, slave versions of the Managed version are available that can be managed (along with the master) as one system.

PDUs with a switching function can support troubleshooting and repair in IT systems, if a computer cannot be reset by any other means than via a switched-off a socket. With this range of PDU functions and higher, a display is usually also incorporated, in the device, which the administrator can use to read the most important parameters and settings on site. Access via the network is also generally possible with high quality PDU models. For this purpose, a web server, accessed through a browser, is installed in the device. If the PDU understands the SNMP (Simple Network Management Protocol) network management protocol, it can also be incorporated in higher-level management frameworks.

Most PDUs support the connection of temperature or humidity sensors in order to control the environmental parameters. There are often also switch contacts that can trigger actions in the rack or monitor rack events, for example, whether the enclosure door is open or closed. High quality PDUs, such as units from Rittal, use a field bus system like CAN-bus (Controller Area Network) to link up sensors or to connect subordinate PDU units, so-called slave units.

The role and position of PDU in the data centre's system environment

PDUs in the server enclosures locally are responsible for collecting data and performing tasks. Although this data can make sense on its own, it offers the greatest benefit when it is used in the context of a higher-level management strategy. With PDUs, savings can be made that make it easier to justify the investment needed to management.

Figure 2: PDUs collect data on site and carry out actions.

Some users argue that an active device, such as a PDU, could fail and that the connected devices would then be affected. Besides this, the wrong server can be switched off because of human error. In a PDU, the risk of failure is actually higher (purely mathematically) than with a simple socket strip. However, it is easily possible to minimize the risk with such redundancy features as a power supply with two separate A/B paths, Power-over-Ethernet and bistable relays. In the last analysis, little can be done against wrong clicks. But the risk of an administrator accidentally pulling the wrong plug on the server rack is at least as high. The probability of error actually decreases if PDUs are correctly integrated into a higher management level. The additional data, together with signal functions – such as LEDs on the sockets – provide guidelines for administrators and technicians. Through the combination of data from the application level and from rack inventory data, the administrator knows that he is just about to turn off a Hewlett Packard blade server, for which the SAP unit in Northern Germany is responsible. This reduces the risk of error.

Criteria for selection and assessment

In most data centres, PDUs are already mounted in each 19-inch enclosure system. The simplest version merely distributes power to multiple output ports. While such systems do represent the simplest and cheapest solution, no advanced features are available. The difference from a multiple power strip bought from the local hardware store is usually only in the better workmanship and the design, which is usually adapted to the specific dimensions and installation concepts of the enclosure manufacturer. But especially those PDUs without any additional functions are increasingly being replaced by intrinsically intelligent units. Rittal offers a complete assortment of PDUs in the form of the PDU international product range, starting with a simple version ("Basic") and extending to a high-end ("Managed") model with switching function and measurement capability for each individual output. A wide selection helps users deploy the right solution (both functionally and in price terms) for their individual needs.

The selection process should not only consider obvious aspects such as load capacity and the number of sockets, it must also embrace the system concept: How can PDUs with their functions be integrated in an existing system, so that their data and functions enrich the overall system? This also includes the questions of how the PDU interacts with other elements of the infrastructure and which costs are caused by the integration. Ideally, a PDU is another element of the "modular" data centre infrastructure. It fits perfectly into the rack system that can handle the load consumers to be switched as servers, switches, and air conditioning equipment and it is administered by the management software without any programming effort.

Nevertheless, there are a wide range of PDUs with specific selection criteria, ranging from mechanical processing, redundancy functions, accuracy and safety features that potential buyers ought to compare attentively. Often seemingly small details may later have a dramatically effect on operation.

Mechanical features

The list of decision criteria starts with design and mechanical features. Potential customers should first ask for the appropriate enclosures. Will the PDUs fit in the enclosure system(s) used? And if so, will they fit in the enclosure systems, as they will be appear in a fully installed condition? Larger PDUs need enough space for themselves and for the inserted plugs and cables. Rittal uses the zero-u-space system in the Rittal TS IT enclosure, i.e. in the space between the side panel and the 19-inch support frame. There, the socket strips do not occupy any valuable space on the 19-inch level and they are easy to reach, even if the rack is fully populated. The power cables can also be easily guided and fastened in this space.

In the case of PDUs that a manufacturer offers alongside its own enclosure systems, one can assume that the socket strips can be mounted without much effort. However, it often happens that a tool can fall down during installation and that its sharp edge may slash a cable or even completely cut through a wire. However, Rittal's PDUs are attached in the zero-U-space without any tools. This reduces the installation time and prevents damaged cables. Mechanical compatibility (in other words fitting PDUs from manufacturer "A" into enclosure systems from manufacturer "B") can nowadays usually be accomplished with the aid of adapters for the respective mounting rails. In larger environments with many dozens or even hundreds of PDUs, accessories represent a cost factor. Rittal, however, provides free universal fasteners for each PDU as standard.

Users should not make false economies. A socket from the local hardware store is no suitable replacement, even for a simple PDU that has no special features. DIN VDE 0100-420 (VDE 0100 part 420) section 4.1 states clearly that electrical equipment must not represent any fire hazard for the environment. In particular, low-cost portable multiple socket outlets and extension cords for temporary use in household and domestic areas always keep finding their way into industrial environments. A great deal of fire damage has resulted from portable multiple sockets and their improper use, as confirmed by the fire loss statistics of the fire insurers[4].

It can also be problematic if a small PDU with a few sockets is first purchased, which then acts as a distributor for other PDUs if and when additional servers are added within the enclosure. Due to the possible overloading of the contacts and a corresponding generation of heat, the users risk failure and, in the worst case, fires.

[4] Holger Blum (2006): Brandgefahr durch ortsveränderliche Betriebsmittel. In: de - das elektrohandwerk, Ausgabe 04-2006, S. 32–36.

Sockets: Quantity and design

PDUs need to serve as distributors for mains voltage and current. To serve this purpose, they must be able to manage the load capacity of the connected consumers. This can vary extremely in different racks. If memory systems are installed, the hard drives often draw enormous currents, at least as long as conventional magnetic disk drives and no SSDs are used. On the other hand, numerous small servers with one height unit ("pizza boxes") require many sockets but the power consumption per server is very low, because these devices usually manage without any hard drives and only perform computing tasks.

Figure 3: A three-phase system is sufficient for almost all applications within the rack.

Rittal products are available in one or three-phase versions and with 16, 32 or 63 amps. The three-phase version with 63 amps per phase distributes somewhat more than 43 kW. If a redundant distribution with two PDUs and different supply paths is established, nearly 90 kW of electrical power per rack can be channelled to the consumer! However, only rarely are such high capacities necessary, for example in the field of high performance computing or if elements of the climate control have to be monitored. Because the load capacities of the PDUs are a major cost factor, it is extremely important for users to determine the current and future loads in advance and to select the PDUs accordingly. As a rule, almost all the applications in the rack can be supplied by a three-phase system with 16 amps per phase.

Flexibility required

The next item: Which connector format do the terminal devices use? In Europe, the classic socket with earthing contact (grounded socket) is often used. It is robust and the high insertion forces prevent the plug from being pulled out accidentally. However, non-heating appliance sockets (C13/C19) save a great deal of space and provide much higher connection densities. That is why these sockets have become established as an international standard in data centres. However, the low insertion forces are a disadvantage, as plugs can be removed by mistake. But the problem can be solved by using suitable cable lock devices and withdrawal prevention systems.

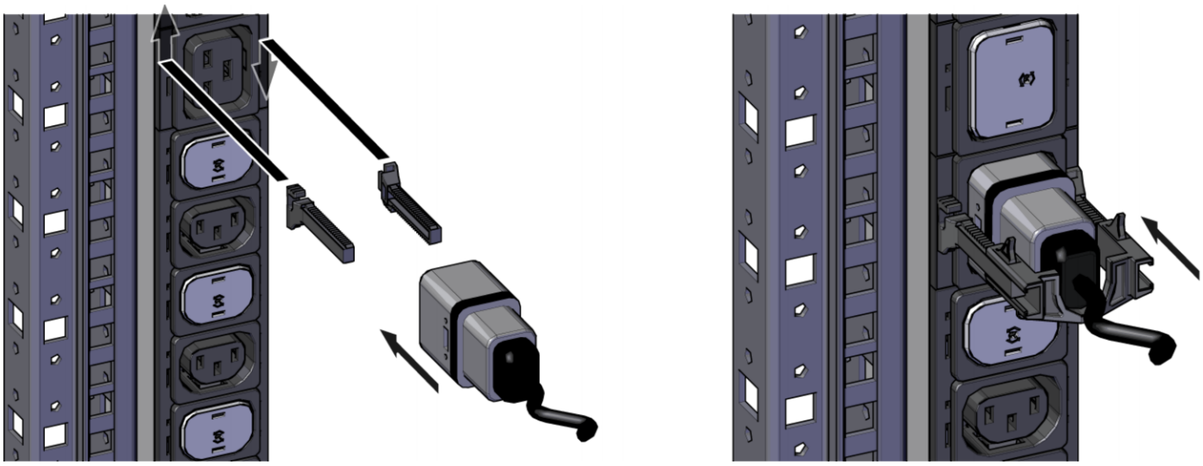

Figure 4: Cable lock devices and withdrawal prevention systems prevent plugs being pulled out by mistake.

The classic C14 connector is can only withstand currents of up to 10 amps. Large consumer devices such as blade server power packs therefore use the C20 high load version with a load capacity of up to 16 amperes. The PDU must at least be capable of supporting these connector formats. In the ideal case, the system is modular and customers can mix different plug shapes in a PDU as required. This can also be helpful if devices with plug formats from other countries, e.g. from the UK, are to be used in the same rack. It would also make sense to protect any unused slots from unauthorized access. If these slots are protected by covers, this firstly means more safety for users. If the covers are lockable, an administrator can also effectively prevent equipment being installed and connected in the rack without permission. This feature makes a large contribution to complete documentation.

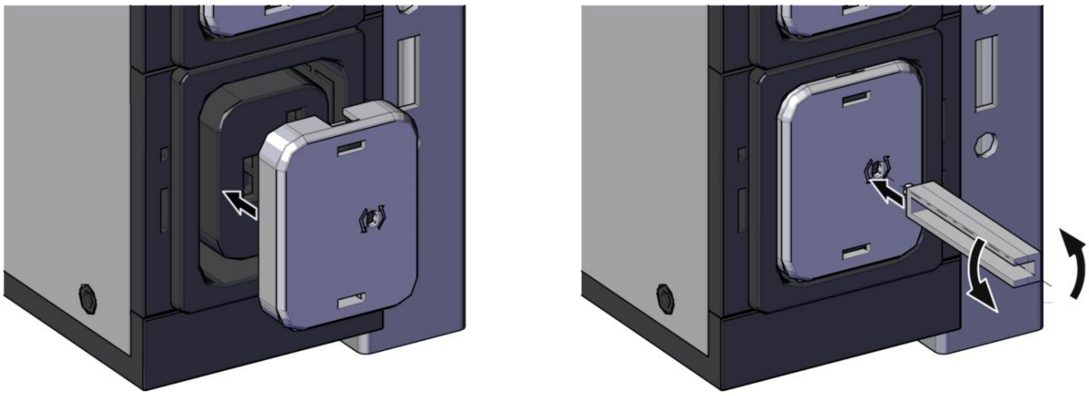

Figure 5: Unused electrical sockets should be protected against unauthorized access.

The well-defined the sockets on a PDU are marked, the less likely that there will be any confusion in the heat of the moment. A colour code for the phases together with clearly designated A/B supply routes is ideal. If the individual slots can be marked by LEDs or by other visual indicators it will make service calls easier. This way the devices to be unplugged can be directly and clearly marked on the PDU. Often it is at least possible to indicate the switching state of the socket optically.

High demands on the material

The fact that the material must meet the high demands in the server enclosure of a data centre is also clear. The temperatures at the entrance to the server in very many data centres have been defined by the ASHRAE guidelines. Over the last few years, these guidelines have been adapted to the demands for improved energy efficiency. This would have resulted in higher inlet temperatures being allowed for the server. However, this would also have led to higher waste air temperatures at the rear of the server. PDUs are very often exposed to this waste air, either directly or at least partially. At an inlet temperature of 27°C, servers expel warm air flows at 42 to 45°C. The enclosure and all the components must be able to reliably operate at these temperatures over a long time. Rittal's PDUs are approved for ambient temperatures of up to 45°C.

In addition to the risks arising from the physical elements, the PDU must also be protected against overvoltage surges. In the case of a PDU, this is more important than with other components in the data centre, since PDUs must protect the end-users connected from the effects of the overvoltage. Extremely quickly reacting circuit breakers are thus vital. The PDU must be protected against overload due to excessive currents and short-circuits.

Data centres grow, making expandability within the racks an important issue. Even if Rittal offers PDUs with up to 48 slots, for example, it may be that users will need even more slots. Of course, one can install a second PDU in such a case. However, management is more economical and easier if the manufacturer implements the master/slave concept, as practised at Rittal. Slaves are similar to the standard PDUs, but have no display and no network connection. Instead, they are connected via CAN-bus to a master-PDU or – if one is available in the rack – to a computer multi control system (CMC III). The CMC is a monitoring system that is connected to the data network via Ethernet. CMCs can manage up to 32 external sensors and devices, such as PDUs, in addition to the built-in sensors. Regardless of the number of slaves, the administrator sees only one logical PDU with the total number of slots and functions. The connection between master and slave is usually proprietary, though with Rittal, a CAN (Controller Area Network) bus is used. This bus needs a few current-carrying conductors and can be used over long distances with thin and flexible cables.

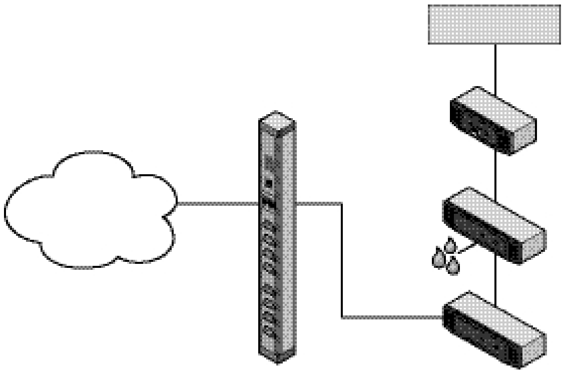

Figure 6: External sensors connected via CMC III and CAN bus.

Environmental data from the rack level

Almost all PDUs can gather environmental data on temperature, humidity or the state of switch contacts for example via optional sensors. Rittal's PDUs can be connected via four sensors from the CMC III controller range. Administrators can so gain a detailed overview of the environmental conditions on site, and can integrate monitoring functions within the data management. The switching contact reports, for example, whether the door has been opened and whether someone has access to the rear of the server. Under certain circumstances, the PDU offers universal ports such as USB which can operate webcams, for example. The manufacturer should also regularly provide firmware updates that can be installed during operation via the network. To ensure high availability, updates need to be protected against corrupted image formats and transmission errors.

Switching function of the PDU

As a rule, PDU manufacturers divide their products into those with measuring and with measuring/switching functions. This is because some customers reject PDUs with switching capacities for safety reasons. On the other hand, in some service applications, for example when no specialists are on site, the computer must be rebooted by switching off the power supply. Depending on the provider, the sockets can all be switched or just some of them. Rittal even allows sockets to be combined as groups and to form functional blocks that must start at the same time. If a company's security management system is working, this switching function does not represent an unreasonable risk.

The PDUs perform the actual switching process in two different ways. The loads can be switched with electronic or mechanical relays. However, during a power failure affecting only the PDU, both electronic and mechanical relays lose their control current and fail. Normally the slot concerned and its consumers are switched off. In addition, a constantly energized, mechanical relay consumes energy. This can add up to 50 watts in a fully populated PDU. This energy consumption is unnecessary and it reduces the service life of the continuously operating relay.

Figure 7: Rittal uses OLED technology to reduce energy consumption.

Rittal's implementation using bistable mechanical relays is more economical and much safer. They are only activated if the switching status needs to be changed; then they remain in this state. If the supply to the PDU fails, the switching states of the individual sockets do not change. Moreover, no unnecessary power consumption is caused by the coils of the relays – they remain passive in operation. This dramatically improves a PDU's energy efficiency. Ideally, the manufacturer also pays attention to minimizing the consumption of the other elements of the PDU. If a display is installed in the device, it may be responsible for a large proportion of the PDU's current consumption. Energy-saving display technologies like LCD or OLED (Organic LED), which Rittal also uses, help to lower this value as much as possible.

Redundancy for the PDU

The power supply to the PDU itself is a crucial factor in the concept of redundancy, especially when PDUs with switching options are concerned. Typically, the PDUs are supplied from a different source than the connected load. If the server has redundant power packs, an additional A/B supply is installed in the racks. This can mean three different supply lines to the rack, resulting in great expense for data centre operators. The problem can be solved more elegantly by having the PDU powered by the already existing network interface using Power-over-Ethernet (PoE), as is possible with Rittal. This means saving one supply route, even though full redundancy is still obtained by separating the load and control supply. Rittal models with three phases rely on all three phases for power supply to the PDU so that the failure of one phase has no effect on the PDU's measurement technology and switching function.

Measurement technology

What the PDU actually has to supply in terms of readings is down to the decision of the individual user. If energy efficiency is all that matters, awareness of the accumulated powers in the different phases that lead into the data centre may be quite enough under certain circumstances. But then one misses the chance to recognize untapped potentials at the application level. A measurement of current and voltage down to the rack level is actually the minimum needed in order to obtain a practical insight into the energetic conditions within a data centre. After the widespread installation of PDUs with metering functions, customers often discover that in practice, power supplies which are apparently fully utilized still contain a lot of untapped potential. Threshold values can also usually be set for consumption, so that admin is automatically informed of any increasing load.

Depending on the manufacturer, the PDUs can gather a wide variety of measurement data. The frequency and voltage and current and the product of these (power) are obligatory. Depending on the quality of the PDU, it also measures active and apparent power – important factors when power supplies with capacitive and inductive load characteristic are used. This also applies for the power factor. It is decisive in connection with uninterruptible power supplies (UPSs). Because UPSs are normally designed for inductive loads, a power factor of +0.8 (inductive) can be expected at their output. However, with present-day blade servers, the power factor lies between -0.95 and -0.90 (capacitive). As a result, conventional UPS systems approach their capacity limit much faster than the planners had taken into account during installation. Anyone who knows the actual performance factors can better calculate the load and dimension the UPSs optimally in the event of extensions.

Particularly when three phases are used, it is vital to distribute the load symmetrically. A neutral wire (PEN) measurement can save a great deal of planning and testing, because it perfectly depicts the ratio of the load. If the active energy, i.e. the power divided by time, can be measured at each stage, it is also useful to immediately convert the consumption values into the costs arising.

Measuring accurately and long term

The question of how the measurements are exactly made is a critical differentiator with PDUs. Given the long acquisition duration, major differences can accumulate over time and greatly distort the true conditions in the racks. Often, different levels of accuracy are stated as reasons for the individual measuring ranges. Rittal PDUs record the energy consumption (kWh) with an accuracy of +/- 1%. All other values are detected with an accuracy of +/- 2%. The accuracy values have to be maintained over the complete temperature range, because the PDU is almost always exposed to the hot waste air from the server and reaches the high temperatures inside.

As a rule, a PDU should not only provide snapshots of the current situation, but also log data over a long period. The more data points are calculated per second, the more accurate the image that the administrator receives from the data centre. This so-called sample rate should be as high as possible, but not so high that the network is burdened excessively by the values issued. If the manufacturer integrates a buffer battery in the PDU, the measurement values last recorded are retained for a while, even during a power failure, so that the detection of the parameters is free of gaps.

Like any other electronic system, a PDU has a certain susceptibility to errors. Because it turns on and monitors important systems, availability plays a bigger role than with comparatively unimportant electronic components. Users should ensure a mean time between failures (MTBF) that is as high as possible, even if this value offers no absolute certainty about the frequency of failure (Rittal: 80,000 hours). In order to achieve the highest possible availability, additional measures have to be taken, for example, a redundant supply of the server via two separate PDUs, each with separate power feeds.

Relevant approvals and compliance

Meeting compliance requirements may mean extra work and costs for companies, but it usually ensures a clear improvement in the level of safety of the companies affected. Depending on the industry and the area of application, PDUs must meet higher-level specifications and certainly bear a CE mark. The relevant safety requirements are formulated in the EC Low-Voltage Directive 2006/95/EC. One important standard for information technology devices, including PDUs, is EN 60950-1 of 2006. Part 1 of the standard defines the general requirements that must always be met by the PDU. If companies are owned by foreign parents, further approvals and tests such as UL (Underwriters Laboratories) may be necessary for compliance reasons.

Even the basic IT protection provisions of the Federal Office for Information Security (BSI) contain information on PDUs, at least as regards their current distribution function. For example, module G 4.62 lists hazards that can occur when using inadequate socket strips. Measure 5.4 M recommends the BSI enclosure view diagrams for the correct description of the built-in passive and active components, including the socket strips, as well as the physical and logical connection diagrams of the power network.

Software/web interface:

Users must be able to communicate with the PDU via one or more paths. At one time, manufacturers used to provide dedicated software; today a web server, managed via the browser, is usually installed in the PDUs. The browser should be able to connect to the PDU via Secure Socket Layer (SSL). It is best when this encrypted form of communication is provided as standard. Data centres over a certain size already employ a management framework in which the PDU must be integrated as seamlessly as possible. The data arrives at the management console because the devices typically support SNMP (Simple Network Management Protocol), which is guaranteed at least at a basic level. However, users must clarify whether the data can also be sensibly integrated in the interface and database of management software: Only then can they be simply linked to other data, events and actions.

Figure 8: Rittal PDUs are optimally integrated in the RiZone DCIM software.

Readings are only one form of data available, it is also important that the PDU issues alarms when certain values are exceeded. For one thing, this can happen in the higher-level management software, but it must also be directly supported by the PDU. Thus, the administrator should receive a message immediately in the event of such critical values as drastically high currents or extreme fluctuations in frequency and voltage. Email is the standard communication for human contacts. SNMP traps exist for software receivers. SMS should be possible as an option in particularly important cases. High-quality PDUs enable the combination of values and actions, so that “if-then” constructs become possible. The external sensors must also be integrated in these alarm functions. This means that it should be possible to record and log open and closed enclosure doors via switching contacts.

The latest PDUs should have an intuitive and clearly structured operating concept. If companies already use an infrastructure management software in the data centre (DCIM - Data Center Infrastructure Management), PDUs from the same manufacturer fit especially elegantly into the existing concept. The same “look-and-feel” simplifies operations enormously; users can operate the PDU immediately and without any learning process. Users of Rittal’s RiZone DCIM software, which Rittal PDUs also employ, also have the same experience. Both the functions and the operating concept fit together perfectly. In addition, RiZone already contains the PDU’s management information base (MIB). All the parameters of an electronic device with their addresses are stored in the MIB. A management software can read out all the data on the MIB and has write-access to the device. However, it does involve the effort of integrating the MIBs in the management software. Because the Rittal PDU’s MIB has already been integrated into RiZone, all the functions of the intelligent socket strips can be used immediately.

Security

Anyone using intelligent PDUs can execute very powerful control functions, and check protection systems for signs of physical danger. This potential must be carefully protected from abuse. It is obvious that an unjustifiably disconnected socket can wreak great damage on the device it supplies. But anyone who is capable of disabling warning messages in the event of overload or preventing an alarm by opening an enclosure door has a far greater potential to abuse. Security must first therefore be ensured by planning and then by appropriate technical measures.

Firstly, it is important to clearly define those people who have access to this feature. To define who shall have access, many modern PDUs have integrated clients for directory services. They can be connected via Lightweight Directory Access Protocol (LDAP) to the Active Directory or to another directory service of the company, and use the company-wide user information for granting access rights. If this is not possible or desired, e.g. because the administrators want to manage this user group themselves, the PDU should provide its own user management.

When it comes to the aspect of “which people”, it is most important to divide the capabilities of the PDU in as “granular” a way as possible. The larger the operational environment, the more likely that different people will be responsible for different areas of administration. It should be possible to group thematically related PDUs and their individual ports in terms of rights. For example, admin (responsible for the mail server) does not need access to the SAP servers. Approvals are best divided into read and write rights. Thus, a fault-seeking administrator can, for example, check the status of a power supply, but not make any change himself.

HTTPS encrypted via SSL should be generally used when accessing through a browser. When PDUs communicate with higher-level management software, this is via SNMP. SNMP versions 1 and 2 have no security functions, and passwords are transmitted in clear text. Only SNMPv3 (RFCS 3410-3419) adds a viable security model to the existing functions and should be preferred. SNMPv3 employs the user security model (USM) for protection against the multiple threats that may occur in an SNMP-managed network.

For security reasons, the Ethernet switches that connect the PDUs to the network management system should not be made via switched sockets, so that you cannot lock yourself out of the PDU management interface by mistake. Anyone who wants to ensure that only the correct socket is switched, first has to do their homework: Correct documentation, meaningful processes in relation to changes and new installations, and consistent access control all prevent errors and sabotage.

Hardware-independent conditions for planning and preparation

No matter which PDU from which manufacturer is used, some basic questions should be answered prior to selection and usage. First, the PDU must fit into the enclosure mechanically. Then the anticipated electrical load is estimated and defined with a safety margin. Generally, answer to the question of whether the PDU should be single or three-phase is dependent on this. When it is clear which power has to be distributed, the next question should deal with the consequences of failure: Which level of redundancy is needed in the server cabinet and how it will be implemented using the PDU? The supply for the PDU's measuring unit must be controlled, either via the mains voltage supplied for the server or via a third channel, for example, power-over-Ethernet or another supply busbar. Finally, the number of servers in the rack that can be connected via the ports of the PDU also depends on the redundancy. With dual power packs, each server requires twice as many sockets as a non-redundant powered device; but blade servers with up to eight power packs do exist that occupy a corresponding number of slots.

Then aspects need to be addressed that are concerned with integration in the management framework: Which data can the management system evaluate? And which information is in demand at all? If you do not want to break down the accounts to the server level, you will probably not need a PDU with sensors for each individual socket.

Security also includes other aspects. Whoever has control of PDUs can do what they want in the servers. Administrators should ensure, as far as possible, that they can assign granular access rights. Not only for the entire PDU, but also for individual functions or even for individual sockets. The access rights must be carefully planned and documented after implementation.

List of abbreviations

BSI	–	Bundesamt für Sicherheit in der Informationstechnik (German Federal Office for Information Security)
CAN-Bus	–	Controller area network bus
CMC	–	Computer Multi Control
CEE	–	Commission internationale de réglementation en vue de l'approbation de l'équipement électrique
USB	–	Universal Serial Bus
DCIM	–	Data Centre Infrastructure Management
EEG	–	Erneuerbare Energien Gesetz (Renewable Energies Act)
IT	–	Information Technology
kW	–	Kilowatt
LCP	–	Liquid Cooling Package
LDAP	–	Lightweight Directory Access Protocol
LED	–	Light Emitting Diode
MIB	–	Management Information Base
MTBF	–	Mean Time Between Failures
OLED	–	Organic LED
PC	–	Personal Computer
PDU	–	Power Distribution Unit
PoE	–	Power-over-Ethernet
SAP	–	Business software provider
SNMP	–	Simple Network Management Protocol

SSD	–	Solid State Disk
SSL	–	Secure Socket Layer
TW	–	Terawatt
UPS	–	Uninterruptible power supply

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