WHITE PAPER

Additional Considerations When Selecting Rack-Mount Power Distribution Units (PDUs) and Power Strips

By David Knapp
Product Marketing Manager
Chatsworth Products (CPI)

Published: 01/19; v2 04/20

United States
Agoura Hills, CA
800-834-4969
Canada
Toronto, Ontario, Canada
+905-850-7770
chatsworth.com • techsupport@chatsworth.com

Europe
Buckinghamshire, UK
+441628524834

Middle East & Africa
Dubai, UAE
+971-4-2602125

Doha, Qatar
+974-4-267422

Latin America
+52-55-5203-7525
Toll Free within Mexico
800-201-7592
chatsworth.com.co

Asia Pacific
+86 21 6880-0266
chatsworth.com.cn

CHATSWORTH PRODUCTS

Introduction

Rack-mount power distribution units (PDUs) and power strips (Figure 1) are a well-established solution for distributing power into Information and Communications Technologies (ICT) equipment racks. If you are responsible for selecting or advising selection of these critical components, be sure to review the impact of phase, level of redundancy, functionality on monitoring and reporting capabilities and the ability to integrate other rack-level monitoring hardware through the PDU in your overall consideration.

Definitions in this White Paper

- *Rack(s) refers to ICT equipment racks and cabinets—any 19" EIA rack-mount support structure for computer servers, data storage or network switches.*
- *Rack-mount is used to describe attachment of PDUs or power strips and ICT equipment into data center cabinets and racks.*
- *Rack level is used to describe the placement of PDUs or power strips in both cabinets (cabinet-level) and on racks (rack-level), and the monitoring of conditions inside and immediately around the cabinet or rack.*

This white paper, by Chatsworth Products (CPI), presents additional considerations when selecting PDUs and power strips. It covers key concepts and features that enhance reliable power delivery and monitoring at the rack level. It concludes with resources that will help you select the right PDU or power strip for your application.

Fast Fact

If you are already familiar with selection of PDUs and power strips and just need to find a part number quickly, try the CPI Power Selector, www.selectapdu.com. If you would like help selecting a product or have a technical question, please contact our Technical Support department at techsupport@chatsworth.com.

Fast Fact

If you are unfamiliar with electrical power distribution systems or first need a refresher on the basics, download the companion white paper: The Basics of Selecting Rack-Mount Power Distribution Units and Power Strips at www.chatsworth.com/whitepapers

Figure 1: Rack-mount PDUs and power strips are used to distribute power into ICT racks and cabinets.

A Quick Review: How Do You Select a Rack-Mount PDU or Power Strip?

Before addressing additional considerations when selecting PDUs and power strips, let's review the four basic steps for selecting a PDU or power strip (*Figure 2*):

Figure 2: Four basic steps when selecting a rack-mount PDU or power strip

1. **Form Factor** – use a vertical PDU in a full-height, free-standing rack to maximize possible equipment connections. Use a horizontal PDU in smaller wall-mount racks.

2. **Input Plug** – must match the branch power circuit receptacle at the rack and determines the total amount of power available to equipment in the rack.

3. **Outlets** – match the plug(s) on equipment in the rack. There are two approaches: either select the model with the highest number of outlets used in region, or select the model with the highest number of mixed C13 and C19 outlets.

4. **Functionality** – match the level of monitoring required: no metering, local metering, remote monitoring of the input and breakers, remote monitoring including each outlet, remote control of outlets, or remote monitoring and control of outlets.

For a detailed explanation of these four key decisions, download the companion white paper: The Basics of Selecting Rack-Mount Power Distribution Units and Power Strips at *www.chatsworth.com/whitepapers*

Power Distribution and Conditioning

Rack-mount PDUs and Power Strips primarily function to distribute power into racks. However, some models have optional surge protection and breakers. You should also consider the impact of the level of redundancy and how equipment is plugged to maintain load balance on three-phase models.

Optional Surge Protection

Surge protection is circuitry within the PDU or power strip that protects against voltage spikes. This feature is not required in purpose-built facilities, data centers and computer equipment rooms that have power conditioning through a Transient Voltage Surge Suppressor (TVSS) and Uninterruptible Power Supply (UPS). In premise equipment rooms or at the network edge, where equipment is powered directly from utility power, advise surge protection.

Surge protection is typically specified by a voltage limit. If the amount of line in Voltage exceeds this amount, it is clipped. Surge protection may be limited to a certain number or strength of voltage spikes, after which the unit may continue to deliver power, but without surge protection. So, there may be an LED on the PDU or power strip to indicate surge suppression is active.

PDU Breakers

The breakers on a PDU divide the input power between groups of outlets and limit the amount of current shared by those outlets to prevent overloading of the branch circuits on the PDU and the branch circuit supplying the PDU. If power draw from attached equipment exceeds the current limit, the breaker on the PDU opens, like a light switch, and power stops flowing to the equipment attached to the associated outlets. This prevents power loss for all equipment attached to the PDU and the branch circuit supplying power to the PDU. Basic power strips may have a simple thermal circuit breaker, but breakers on PDUs in high-density racks and aisle containment that will be exposed to high temperatures should have hydraulic-magnetic breakers that are UL® Listed to the UL 489 standard[1] (Figure 3).

Figure 3: Low profile, hydraulic-magnetic breakers that are UL Listed to the UL 489 standard are best suited for the high temperatures in contained aisles in purpose-built high-density data centers.

Metering, Monitoring and Functionality

Product functionality, or what can be monitored, is determined by the internal metering within the PDU or power strip. The unit may have metering for the input current, at the breakers and/or at the outlets (Figure 4). Be sure to check the product specifications to understand what it can measure, the level of accuracy of the measurement and the regularity of the measurement. Be sure the monitoring functionality that you select captures the data that you need.

One of the advantages of local metering and remote monitoring at the input and breakers on a PDU is the ability to see power draw and changes as new equipment is attached. The thresholds of the breakers are known, typically 15A, 16A or 20A, and if the measured value is close to the breaker value, it is best to plug no additional equipment to prevent an open circuit. Likewise, since power use by equipment varies with workload and utilization level, remote monitoring, logging of power values and trending with a Data Center Infrastructure Management (DCIM) software can help you locate and adjust available power capacity.

CPI Metered PDUs and power strips provide continuous input current monitoring.

CPI Monitored, Monitored Pro, Switched and Switched Pro eConnect® PDUs provide continuous input current monitoring and continuous voltage (V), current (A), power factor, power (kW) and energy (kWh) monitoring for each branch or phase breaker on the unit with ±1% accuracy power measurement.

CPI Monitored Pro and Switched Pro eConnect PDUs also provide continuous voltage, current, power and energy monitoring for each outlet on the unit.

Figure 4: Metered PDU with LED panel to show input current on each phase (L1, L2, L3).

UL Listing – Independent, Third-Party Safety Testing and Review

Ensure the product has been tested by an independent, certified, third-party laboratory for safety and performance. Safety standards, like the Underwriters Laboratory ANSI/UL 62368 Standard for Audio/Video, Information and Communications Technology Equipment - Part 1: Safety Requirements[2]; and ANSI/UL 60950 Information Technology Equipment - Safety[3], provide industry guidelines for testing and qualification. Individual test labs offer several categories of listing for power products. Listed products are identified in the test labs online database of listings and the product will include a label identifying the testing agency and listing (Figure 5). Third-party testing is especially important with electrical and electronic products.

Figure 5: Product label from CPI eConnect PDU showing UL Listing

Listing typically includes evaluation of components to be sure they support the product specification. Additionally, in commercial applications, some electrical codes require electrical distribution products to be tested and listed by a certified lab. Note that the CE marking (Conformite European)[3] does not require third-party testing.

CPI PDUs and power strips are UL Listed under the AZOT category[5], Audio/Video, Information and Communications Technology Equipment; and the NWGQ category[6], Information Technology Equipment Including Electrical Business Equipment, file E212076.

Fast Fact

UL 62368 is the new safety standard for rack-mount PDUs effective December 2020.

Plugging Equipment for Redundant Power

In the simplest configuration, equipment has a single power supply and cord, and is plugged through one power circuit and one PDU or power strip. However, most rack-mount equipment has dual power supplies and dual cords to support redundant power. The idea in redundant power configuration is to feed the rack from two separate power circuits (sources) into two different PDUs or power strips and to plug equipment across both circuits, so that if one is interrupted, the other will continue to power all equipment (Figure 6).

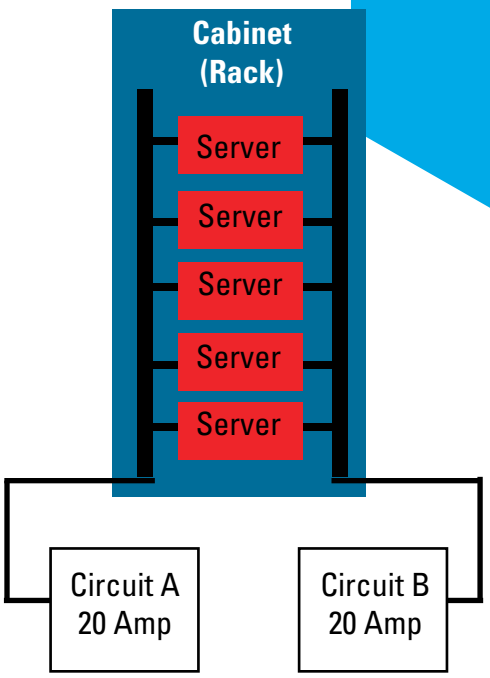

Figure 6: Diagram of dual-cord equipment and redundant power

Note that the equipment may be configured to draw all power from one cord and to switch to the alternate cord if power is lost, or to share power across both cords. Regardless, in a redundant power configuration, each PDU or power strip must be able to support the full power load of all equipment in the rack.

CPI eConnect PDUs are available in redundancy pack, a matched pair of PDUs (one black and one white) to provide easy visual identification of the primary and secondary unit.

Monitoring Input Current on Three-phase PDUs

Measure and monitor input current (each phase) on three-phase PDUs to ensure the power draw is balanced across phases. You can redistribute plugs onto different outlets to balance power. If using remote monitoring, be sure input current is one of the values presented (Figure 7). When combined with DCIM software, power trends can be compared with known capacities to estimate remaining capacity and to estimate if there is sufficient failover capacity in each rack.

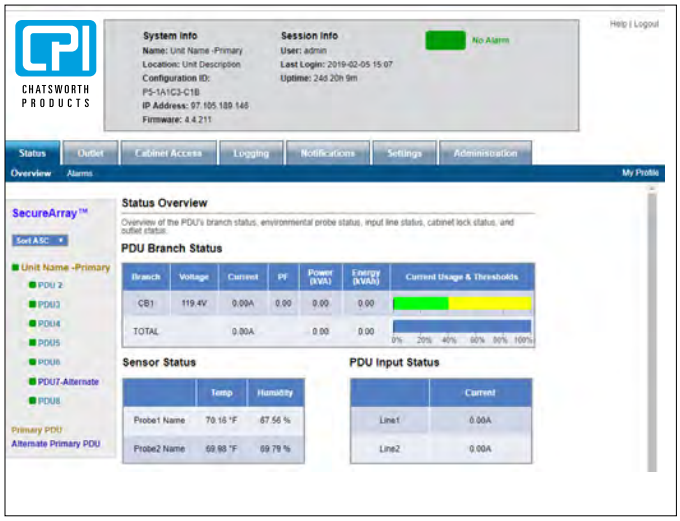

Figure 7: CPI Monitored Pro eConnect PDU has local and remote monitoring of power at the input, breakers and outlets. Measured values are presented on the LCD screen, through the PDU web GUI and can be shared with DCIM and other third-party monitoring software.

Plugging Equipment into Three-phase PDUs

When plugging equipment, it is critical to plug across breakers and phases to balance power draw of equipment. CPI PDUs have phase-balance outlets and clearly marked and color-coded breakers and outlets to assist in identifying phases and breakers (Figure 8). It is also recommended to have a local meter functionality to see metered values for input current and breaker current. You can balance current by plugging loads across phases evenly.

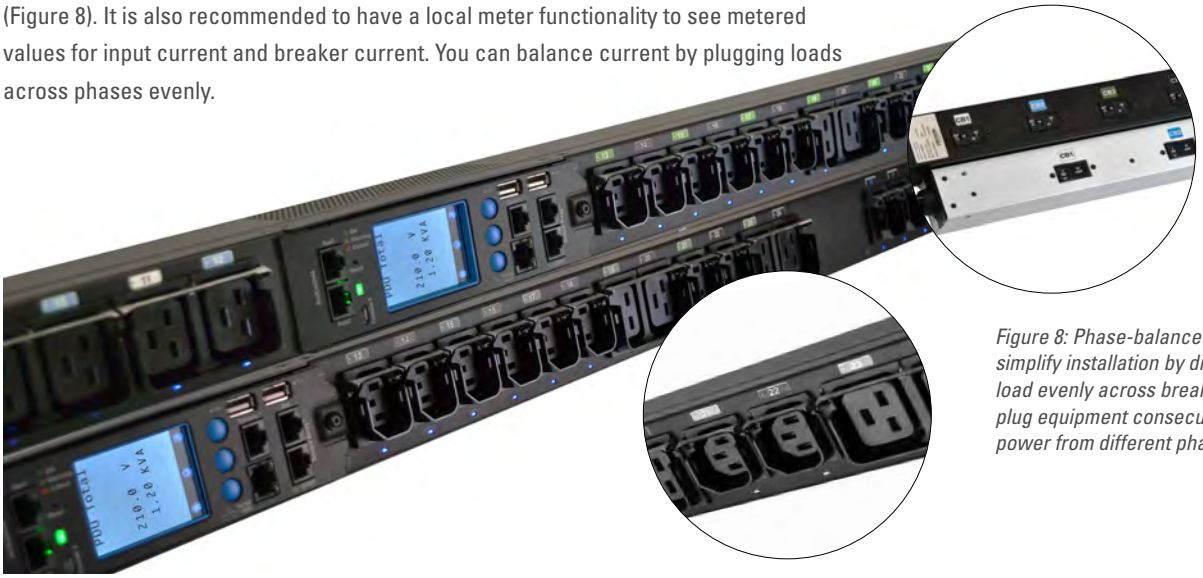

Figure 8: Phase-balance outlets simplify installation by distributing load evenly across breakers. Just plug equipment consecutively to power from different phases.

Fast Fact

Select a PDU with locking outlets that work with standard power cords. Avoid proprietary power cords which could add as much as $250 in additional accessory costs to each PDU.

Remote Monitoring

When attaching any device to the network for remote monitoring, be sure to consider network security, administration, maintenance, the cost of networking the device and operating conditions at the device.

Integrated network security, administration and maintenance

To ensure the intelligent PDU has the widest range of compatibility and security for the network, ensure that it supports the IPv4 and IPv6 protocols for TCP/IP addressing with static or dynamic address assignments, and SNMP v1, v2c and v3 protocols and RESTful API for connection to third-party DCIM software. The web interface should support HTTP or HTTPs sessions with definable ports (Figure 9).

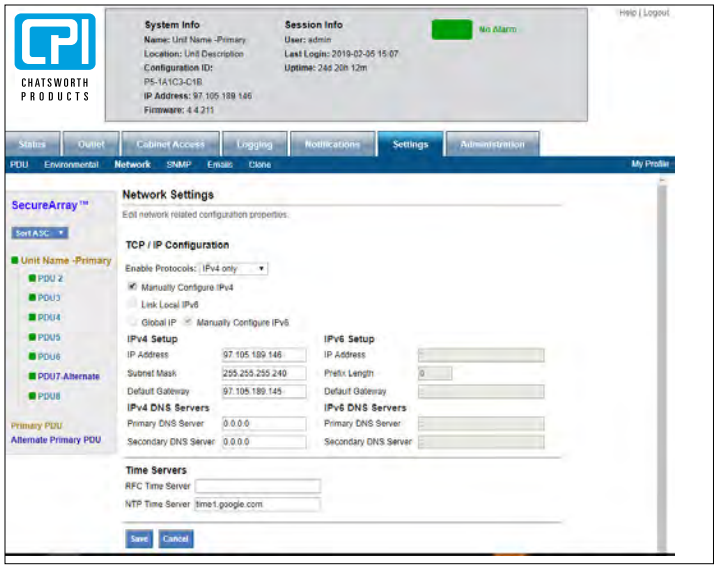

Figure 9: Ensure secure network settings and the most current firmware.

Access should be password-protected with separate user rights levels for administrators and users. The PDU should support authentication from an internal database, LDAP database or RADIUS database. Network connections should support encryption and certificates. Email server connection should be outbound only with TLS protocol and definable ports for security.

For ease of maintenance, the PDU should support bulk configuration and firmware upgrades. The firmware should log every system change. For basic setup, you may want Command Line Interface (CLI) support using a serial connection. This allows configuration using a direct, off-network connection to a computer. You can also use CLI to access PDUs with a remote, out-of-band connection through a console switch. Telnet support is not recommended as it is less secure.

These features are standard on CPI Monitored, Switched, Monitored Pro and Switched Pro eConnect PDUs.

Integrated IP Consolidation

IP Consolidation is sharing a single network connection and web interface for monitoring and control of a group of PDUs (Figure 10). This reduces the total number of network ports required to remotely monitor power, environmental and access control at the rack level in data center, computer room and telecommunications spaces, and can produce significant savings in larger, more concentrated sites.

Look for models that support large arrays, allow a primary and secondary network connection from different PDUs, allow site operators to designate which PDUs in the array are primary and secondary and maintain a connection if one or several PDUs in the array drop connection from the array. The firmware should monitor conditions of the network connection(s), log any array changes, automatically switch over to a secondary connection in the event the primary PDU fails, allow logging from a PDU that is under services to be suspended and support third-party DCIM software.

Secure Array® IP Consolidation is standard on CPI Monitored, Switched, Monitored Pro and Switched Pro eConnect PDUs.

Figure 10: CPI's Secure Array IP Consolidation technology links up to 48 PDUs (32 when electronic locks are integrated) under one IP address.

Critical Firmware Capabilities with Remote Monitoring Functionality

Remote monitoring functionality implies a web interface with access through a network connection and may include monitoring of the inlet current, monitoring at the breakers and/or monitoring at the outlets depending on model functionality. The following list includes critical firmware capabilities for intelligent PDUs that have a remote monitoring functionality:

- Naming of the PDU and individual outlets to associate the PDU with cabinet and rack-mount equipment
- Automated measurement of critical values, including line input current; branch (phase/breaker) voltage, current, power factor, power and energy; and outlet voltage, current, power, energy
- On models that monitor outlet level, ability to group outlets for a combined measurement
- Ability to set and automatically monitor upper and lower thresholds on measured values, especially voltage and current
- Threshold alarms and automated notifications via email
- Logging of measured values on a user-defined interval and for any alarm, notification or event
- Integration with third-party DCIM or monitoring software or hardware including the sharing of measured values and logged events

These capabilities are standard on CPI Monitored, Switched, Monitored Pro and Switched Pro eConnect PDUs.

Critical Firmware Capabilities with Remote Control Functionality

Remote control functionality implies a web interface with access through a network connection and includes the ability to turn individual outlets off, on and to cycle outlets. The following list includes critical firmware capabilities for intelligent PDUs that have a remote control functionality:

- Naming of the PDU and individual outlets to associate the PDU with cabinet and rack-mount equipment
- The ability to turn outlets on, off or cycle outlets
- The ability to set a cycle time to control the power on sequence and prevent inrush current
- The ability to group outlets and control the status for the entire group of outlets through a single click (on, off, cycle)
- Logging of outlet status change
- Integration with third-party DCIM or monitoring software or hardware including remote control function within the software and sharing of the status of outlets and logged events

These capabilities are standard on CPI Switched and Switched Pro eConnect PDUs.

High Operating Temperature Rating

Intelligent PDUs have an operating temperature range that includes the operation of the monitoring and network components within the PDU. Because PDUs are typically placed at the rear of the rack where exhaust heat from equipment concentrates, and especially if using a hot aisle containment strategy when deploying high-density racks, a higher operating temperature is better.

High Operating Temperature Rating of 149°F (65°C) is standard on all CPI eConnect PDUs.

Maintaining Power Distribution if the Controller Fails

Intelligent PDUs include a controller module, a mini computer that provides the collection, connection and reporting of the data measured by the PDU.

One of the concerns when investing in intelligent PDUs is to keep basic power distribution up and running in the event that a controller fails. In most instances, power distribution is not affected if the controller fails. However, the important remote monitoring and control function is lost. Although the failure of a controller is rare, the solution is a PDU with a field-replaceable controller. PDUs with a field-replaceable controller can be repaired in the field instead of replaced. Some controllers include a method of transferring the PDU's identity and configuration to minimize downtime or additional configuration time.

Additionally, on PDUs with Remote Control Functionality, specify bi-stable relays. There are three methods of controlling outlets on rack PDUs. Bi-stable relays maintain the outlet condition if power is lost or if the controller fails or reboots. So, although you will not be able to change the state of the outlets until a failed controller is replaced, the intended state of outlets (on/off) will remain the same if a controller fails.

Field-Replaceable Controllers are standard on CPI Monitored, Monitored Pro, Switched and Switched Pro eConnect PDUs.

Bi-stable Relays are standard on CPI Switched and Switched Pro eConnect PDUs.

Integrating Other Rack-Level Monitoring Hardware Through the PDU

To reduce the cost and complexity of a rack-level monitoring solution, consider the capability of combining a rack-level power monitoring and control system, environmental monitoring system and electronic locking and access control system into a single solution. Combining hardware reduces the number of network connections, the number of power connections and the amount of separate software packages required to fully monitor at the rack level.

Integrated Environmental Monitoring

Environmental monitoring includes a network connection with a web interface for monitoring. A remote sensor attaches to the PDU to share the PDU network connection (Figure 11). The sensor measures temperature and humidity at the rack level. It is recommended to place a sensor near the top of the rack at the front and rear of the rack to measure input temperature and outlet temperature (amount of change) and set threshold alarms for upper and lower limits.

Look for models that can measure temperature and humidity with a maximum range of (+/-) 3 percent accuracy. The firmware should support sensor naming, selection of Fahrenheit or Celsius temperature unit of measure, upper and lower alarms, logging of measured values on user-defined interval and third-party DCIM or management software integration.

Environmental Monitoring is standard on CPI Monitored, Switched, Monitored Pro and Switched Pro eConnect PDUs.

Figure 11: Connect temperature and humidity sensors to the PDU to add rack-level environmental monitoring.

Integrated Electronic Locks for Access Control

Electronic Locks for Access Control includes a network connection with a web interface for monitoring and control. Electronic locks and door open/closed sensors in each cabinet attach to the PDU to share the PDU network connection (Figure 12). The locks control access to all equipment within the rack. You can program employee badges with access permissions or can issue separate employee access badges strictly for access to racks.

Look for models that monitor both lock and door condition and that log every access attempt, including unauthorized or lock tamper attempts. The firmware should support secure login, assignment of individual access rights by cabinet, ability to quickly disable access rights by user, lock handle naming, tamper notification alarms, logging of attempts and door conditions on each attempt and third-party DCIM or management software integration.

Electronic Access Control is standard on CPI Monitored, Switched, Monitored Pro and Switched Pro eConnect PDUs.

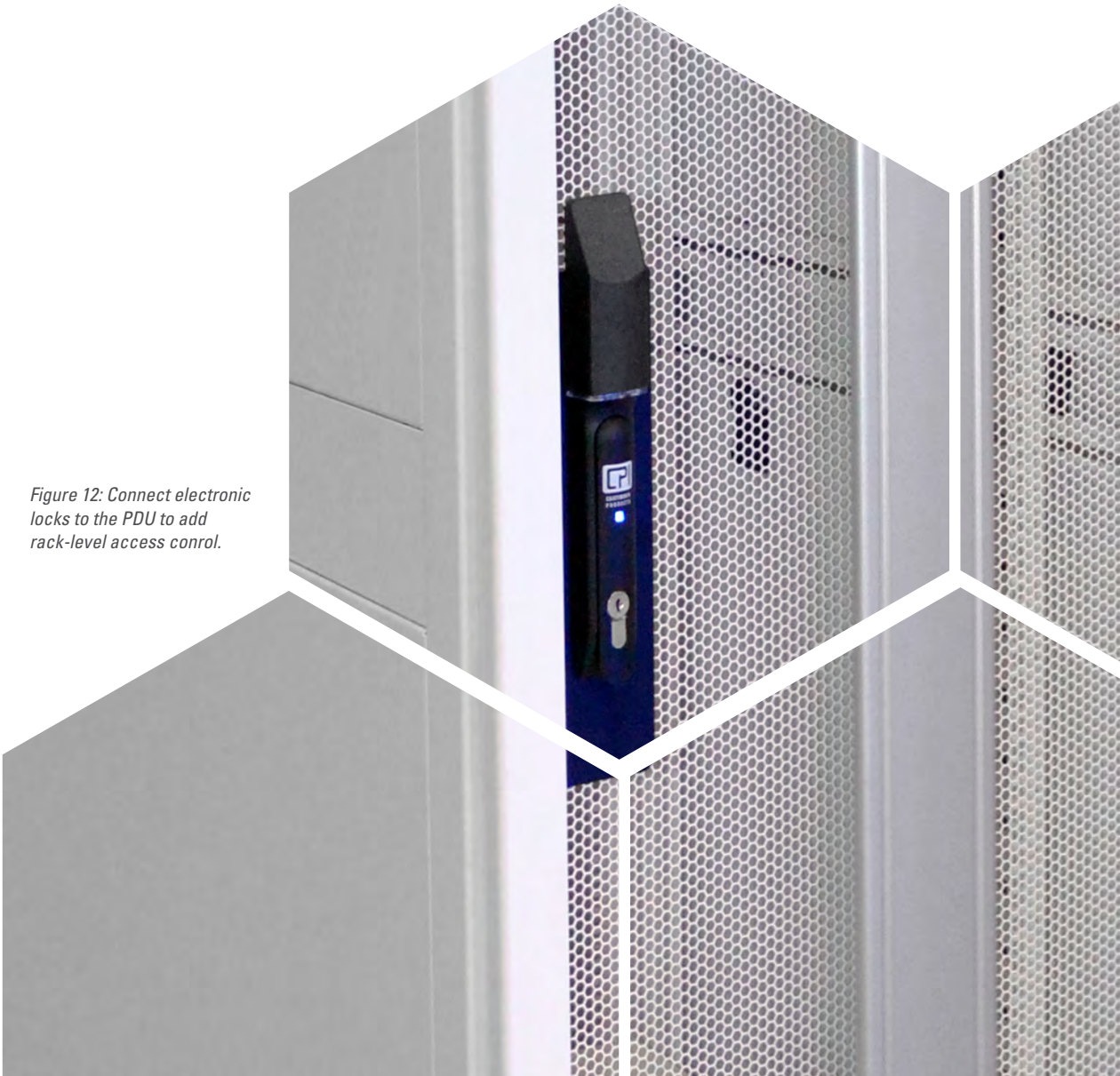

Figure 12: Connect electronic locks to the PDU to add rack-level access conrol.

Reduced Networking Cost with Integrated Secure Array IP Consolidation

Combining the rack-level power monitoring and control system, environmental monitoring system and electronic locking and access control system into a single hardware solution reduces the number of network ports required to monitor a rack from three to one. Integrating Secure Array IP Consolidation technology extends this further by allowing up to 32 PDUs and all attached environmental probes and electronic locks to connect through a single network connection. This greatly reduces the number of network ports, network addresses and network operating cost required to monitor a group of cabinets. The Table below (Table 1) compares estimated cost of a traditional system with separate intelligent PDU, environmental monitoring and access control systems to CPI's integrated ecosystem with Secure Array IP Consolidation technology.

Secure Array IP Consolidation technology is standard on CPI Monitored, Switched, Monitored Pro and Switched Pro eConnect PDUs.

	Estimated Cost Comparison of a NEW Monitoring System for 16 Cabinets						
	Traditional System Seperate PDU, Environmental, and Electronic Access Control			**CPI ecosystem Integrated PDU, Environmental, and Electronic Access Control**			**Savings with CPI**
Component (estimates)	**Qty**	**Each**	**Total**	**Qty**	**Each**	**Total**	
Cabinet Handle Kit (Electronic Locks and Wiring)	16	$1,000.00	$16,000.00	16	$300.00	$4,800.00	$11,200.00
Power Supply for Handle Kit	16	$25.00	$400.00	0	-	-	$400.00
Access Card	5	$5.00	$25.00	5	$5.00	$25.00	-
Access Control Software	1	$1,000.00	$1,000.00	0	-	-	$1,000.00
Environmental Monitoring Appliance	16	$750.00	$12,000.00	0	-	-	$12,000.00
Power Supply for Appliance	16	$25.00	$400.00	0	-	-	$400.00
Environmental Sensors	32	$5.00	$160.00	32	$5.00	$160.00	-
Environmental Monitoring Software	1	$1,000.00	$1,000.00	0	-	-	$1,000.00
Intelligent PDU	32	$1,000.00	$32,000.00	32	$1,000.00	$32,000.00	-
PDU Monitoring Software	1	$1,000.00	$1,000.00	0	-	-	$1,000.00
DCIM Software	1	$5,000.00	$5,000.00	1	$5,000.00	$5,000.00	-
Subtotals			**$68,985.00**			**$41,985.00**	**$27,000.00**
Service (estimates)	**Qty**	**Each**	**Total**	**Qty**	**Each**	**Total**	
Handle Installation	16	$25.00	$400.00	16	$25.00	$400.00	-
Environmental Installation	16	$25.00	$400.00	16	$25.00	$400.00	-
Intelligent PDU Installation	32	$25.00	$800.00	32	$25.00	$800.00	-
New Network Connection	64	$250.00	$16,000.00	1	$250.00	$250.00	$15,750.00
New Power Connection	64	$250.00	$16,000.00	32	$250.00	$8,000.00	$8,000.00
IT Administration, System Setup	4	$500.00	$2,000.00	1	$500.00	$500.00	$1,500.00
Software Maintenance Contract	4	$100.00	$400.00	1	$100.00	$100.00	$300.00
Subtotals			**$36,000.00**			**$10,450.00**	**$25,550.00**
Totals			**$104,985.00**			**$52,435.00**	**$52,550.00**
Estimated Savings with CPI EAC						**$(52,550.00)**	

Note: Pricing is strictly an estimate. Comparison shows the relative differences in component and service quantities for the given systems, but actual unit prices will vary depending on systems selected.

Table 1: Comparison of estimated costs for components and installation of a complete cabinet-level monitoring solution including intelligent PDUs, environmental monitoring and electronic locks and access control. The traditional system uses separate hardware systems, network connections and monitoring software. The CPI ecosystem uses integrated hardware and firmware and Secure Array IP Consolidation technology.

Fast Fact

To see how much CPI eConnect PDU with sensors and electronic locks and integrated Secure Array IP Consolidation technology could save you, try the CPI eConnect Secure Array Savings Estimator
www.chatsworth.com/estimator-page

Integration with DCIM Software

Data Center Infrastructure Management (DCIM) software provides the "single pane of glass" for monitoring all intelligent PDUs, environmental monitoring sensors and other facility sensors in the data center. DCIM software presents measurements in a visual dashboard, which lets you quickly identify issues (Figure 14). It trends measurements, so you can monitor available rack, power and cooling capacity and identify areas for improvement. Depending on the functionality of the PDU, it can report at the device, rack, row, room or site level. Some DCIM software also include network mapping, power line mapping, asset management and/or predictive analytics capabilities.

It is important to understand the differences between PDU levels of functionality and the impact on available reporting through a DCIM software. Think of the PDU as the sensor array and the DCIM as the aggregation and reporting tool. The (Table 2) below compares PDU level of functionality with DCIM report capability.

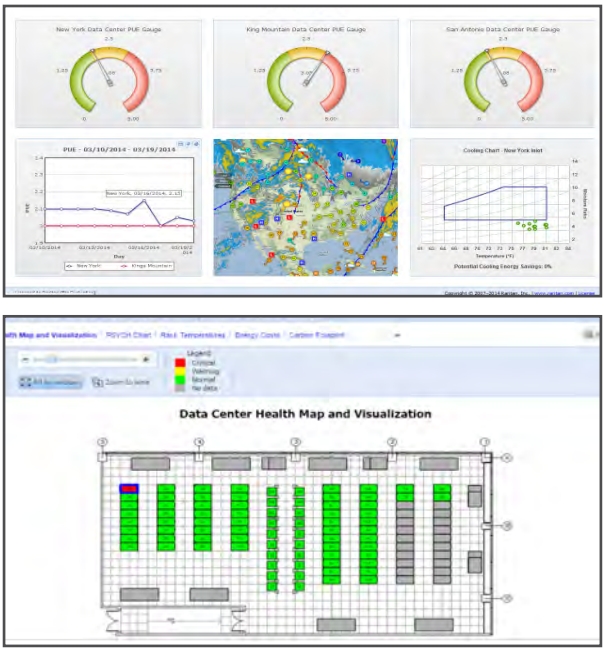

Figure 14: Screen shot of PowerIQ® for eConnect DCIM software showing current conditions of racks

PDU Functionality	DCIM Report Capability
Monitored – Cabinet-level measurement Measures input current and power at the PDU, breaker level.	Logs system events and measured values Monitors for system thresholds and alarms concerns Monitors load balancing on three-phase PDUs Reports power utilization by cabinet against known limit Estimates failover capacity for the cabinet
Monitored Pro – Device level measurement Measures power at the outlet level	Reports power utilization by device Identifies underutilized equipment Identifies overutilized equipment Identifies available U-space by cabinet
Switched – Device-level control Control power at the outlet level.	Identifies conditions of outlets Turn equipment off, on or cycle remotely
Switched Pro – Combines above	All of above
Integrated Environmental Monitoring	Reports temperature and humidity by cabinet Reports conditions within or outside of agreed environmental operating range
Integrated Electronic Locks for Access Control	Reports cabinet access by user or cabinet Open locks remotely

Table 2: Comparison of PDU functionality and DCIM software report capabilities. With outlet/device-level measurement (Monitored Pro), DCIM software can provide reporting at the device, cabinet (rack), row, room or site levels, including available rack space, power and cooling.

Conclusion: Finding the Right Product

This is a companion white paper to **The Basics of Selecting A Rack-Mount PDU or Power Strip** and provides details on each of the four key decisions: form factor, input plug, outlets and functionality. The three key takeaways are to be sure that you understand what monitoring capabilities you are getting for your selected level of functionality (these may vary between vendors); to consider the integration of environmental monitoring, electronic locks for access control and IP consolidation with any intelligent PDU (this will reduce the cost of networking while enhancing rack-level monitoring capability); and to plan to include a DCIM or management software as part of your overall monitoring solution (to consolidate data and automate reporting).

Why Select a CPI PDU or Power Strip?

Monitoring at the rack level provides the data you need to optimize space, power and cooling utilization at your site. CPI designs and manufactures a complete solution for the rack space. CPI has knowledgeable power application engineering to help you identify the best solution for your application.

The CPI cabinet ecosystem includes PDU, rack, cable management, airflow management, environmental monitoring, electronic access control and DCIM software. CPI can be your single source for a complete solution. You can order a cabinet with PDUs and all accessories preinstalled or kitted to match your site requirements. The systems are fully compatible, easy to configure and operate.

CPI has more than 300 standard PDU and power strip models encompassing all functionality levels, form factors and electrical configurations. CPI also provides custom configurations in case standard configurations do not meet all your needs.

Fast Fact

If you would like help selecting a product or have a technical question, contact our Technical Support department techsupport@chatsworth.com.

References

[1]Underwriters Laboratory. UL489 Standard – Molded-Case Circuit Breakers, Molded-Case Switches, And Circuit-Breaker Enclosures. Edition 13. Published 10/24/2016. standardscatalog.ul.com/standards/en/standard_489_13

[2]Underwriters Laboratory. ANSI/UL62368-1 Standard for Audio/video, information and communications technology equipment - Part 1: Safety requirements. Edition 3. Published 12/13/2019. ANSI Approved 12/13/2019. www.shopulstandards.com/ProductDetail.aspx?UniqueKey=36583

[3]Underwriters Laboratory. ANSI/UL60950-1 Standard -- Information Technology Equipment – Safety – Part 1: General Requirements. Edition 2. Published 03/27/2007. ANSI Approved 10/14/2014. standardscatalog.ul.com/en/standard_60950_1_2

[4]European Commission. CE marking. ec.europa.eu/growth/single-market/ce-marketing/

[5]Underwriters Laboratory. UL Product iQ Certifications Database. Chatsworth Products. Listing AZOT.E212076 - Audio/Video, Information and Communications Technology Equipment. Updated 12-13-2019. iq.ulprospector.com/info/

[6]Underwriters Laboratory. UL Product iQ Certifications Database. Chatsworth Products. Listing NWGO.E212076 – Information Technology Equipment Including Electrical Business Equipment. Updated 08-23-2018. iq.ulprospector.com/info/

Contributor

David Knapp | Product Marketing Manager

David Knapp is a Product Marketing Manager at Chatsworth Products (CPI). He has more than 20 years of experience in the telecommunications industry as a product-application expert and technical communicator. He is currently focusing on data center, enterprise networking and power management solutions.

CHATSWORTH PRODUCTS