Data Center Design: From Rack Row to Rack Space

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RACK SPACE
Components of Rack

- Rack
- Cable management
- Power
- Environmental and security
- Software management
- IT devices
RACK
Rack

• Wall mount enclosure
• Vertical wall mount enclosure
• Open frame network rack
• High density networking rack
• Rack enclosure
Wall Mount Enclosure

- Ideal for remote environments
- Mounts to wall
Vertical Wall Mount Enclosure

- Equipment hangs vertical
- Space saving design
- One person install
Vertical Wall Mount Enclosure

Key features and benefits

**Save time**

- **Modular design** guarantees installation can be performed by one technician, reducing installation costs and time to deploy.
- **Unsurpassed weight capacity** allows up to 400 lbs. of critical equipment to be installed.

**Save space**

- **Large cable access openings** on the top, bottom, and sides of the backplate provide increased cable and conduit routing flexibility.
- **50 percent smaller footprint** makes the MiniRaQ an ideal solution for network closets and other small, non-traditional applications.

**Reduce risk**

- **The optional high-velocity, multi-fan module** ensures critical networking equipment stays cool.

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Vertical Wall Mount Options

Sizing options

Compact rack
- Ideal for switch only or IP camera
- Compact - supports equipment from 22-28 inches in depth.

Tall rack
- Ideal for switch and compute
- Tall - supports equipment from 29-35 inches in depth.
Vertical Wall Mount Options

**Configuration options**

**Open rack**
- Sturdy, low-profile, open frame wallmount rack

**Convertible rack**
- Rugged, low-profile design capable of being upgrade to MiniRaQ secure

**Secure rack**
- Locking lid wallmount rack with heat removal, air filtering, equipment mounting and data/cable management accessories

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Open Frame Rack

- 2 or 4 post
- Ideal for network
- Bolts to floor
High Density Networking Rack (HDNR)

Designed for handling high capacity of cables
HDNR High Capacity Cable Manager

Four Post Adjustable Rack (Tapped & square holed rails)  Cable Management Rack  High Capacity Vertical Cable Manager
Cable Management

- Vertical and horizontal
- Attach to two and four post racks
Rack Enclosure

• White reflects light better
• Different U heights, widths or depths
RS Rack Enclosure

Power mounting

Tool-less configuration

Application-specific
PDU Mounting is Critical

Key hole slot for tool-less mounting
PDU Cable Routing

- Top exit for overhead busway
- Bottom exit for raised floor
Configuring a Rack Enclosure

- PDU Mounting Brackets
- Networking top cover with rear open access
- Rails
- Split Hi Flow Door on Rear
- Full Front Hi Flow Door
- Locking Side Panels
- Casters
Tool-less Cable Management

Vertical cable management

Flex tray

Overhead troughs

Cable management brackets
RACK POWER DISTRIBUTION
RPDU Form Factors
Installation

• Mounting buttons are pre-installed to save installation time
• Double-sided buttons accommodate different variations of metal thickness
• Optional side mounting for 90-degree rotation in the rack
Operating Temperature

- Full load UL tested rating
- Required for containment or other hot environments
- Reduces energy cooling costs
Warranty and Packaging

• Standard 3 years
  – 5 year extended warranty

• Environmentally friendly packaging reduces disposal costs
  – 100% recyclable cardboard
Locking Outlets and Cords

- Lever actuated grip outlet using standard power cord
- Now supports P-Lock locking cables
  - Same locking plug used by other major vendors
    (Servertech and Raritan)
Color Coding PDU to Source

- Easily identify A and B power feeds, common:
  - Red and Blue
  - Red and Black
  - 11 options
- Power cables to IT equipment to trace power chain
New UL Safety Standards

• UL 62368-1 will be mandatory in 2020
  – Hazard based safety engineering
• Replaces UL 60950-1 withdrawn 12-2020
Alternating Phase Outlets

- Simplify load balancing
- Reduce cable clutter with shorter cable runs
Understanding RPDU Terminology

**Basic**
Reliable, cost-effective power distribution solution providing branch circuit protection for all connected equipment in your rack. Slim form factor and pre-installed mounting buttons ease set up.

**Metered Outlet**
Provides outlet-level monitoring without control of individual outlets. Increased monitoring capabilities to the outlet level allow you to calculate Level 3 power usage effectiveness (PUE) for the most accurate view of your power utilization.

**High density**
With all the features you have come to expect from Managed PDUs, the HE rack PDU offers the additional benefits of configurability, improved outlet counts and color chassis options. Designed with data center customers in mind, the HD rack PDU offers up to 54 outlets in 32U and alternating phase outlets.

**Metered Input**
Remote monitoring capabilities provide access to your power data whenever you want it, wherever you are. Monitor your critical equipment within each color-coded outlet section from a single interface.

**Managed**
Remote management, outlet-level control and monitoring make this our most advanced rack PDU. Benefit from remotely rebooting connected equipment, turning off unused outlets to prevent unauthorized use and measuring the most accurate Level 3 PUE.
Basic (BA)

- Distributes power to multiple outlets
- May have circuit breakers or surge protection
- No network connectivity
Metering Input (MI)

- Three phase systems require phase balancing
  - Meter display on PDU allows for phase balancing
- Circuit breaker metering
  - Overload metering
  - Trip detection alarming
Metered Outlet (MO)

- Measure power uptime at the outlet for QOS metrics
- Alarm for lost power connection
Switched (SW)

- Outlet level power control
- Full Metered Input measurement
Managed (MA) Switched with Outlet Control

- Control inrush through sequenced power after outage
- Remotely power cycle locked equipment
- Securely power off unused outlets
Local Display

- Advanced pixel LCD display with menu system
- Rotate display
- Set IP address
- Read current, voltage, power, energy and more
- Communications
  - SNMP V1,2,3
  - Telnet / CLI
  - Web browser
Replaceable Network Card

- Common point of failure
- Should be hot swap and touch safe
- Reduces down time
Daisy Chain

• Daisy chain to reduce network connections
• Ideal to link all the PDU in a network closet or for A feed B feed
BID SPECIFICATION RACK AND PDU
Bid Specification

• Review sample bid spec here
Facility Schematic
RACK ATS
Application – Dual-feed UPS

- Dual UPS feed for higher level of redundancy
- Manual or automatic transfer between UPS
- The ATS provides dual feed redundancy to single cord devices
Application – UPS Bypass

- Normal operation UPS power is output to rack PDU
- In event of UPS failure, rack ATS acts as bypass to wall
- UPS can be replaced without loss of power
Application – Dual Feed PDU

- Typical data center dual feed facility level UPS
- Deploy rack ATS to add dual corded redundancy to single corded devices
ENVIRONMENTAL AND SECURITY
Accessory Environmental Probe

ASHRE recommends top, middle, bottom of rack temperature monitoring. Increase data center efficiency with higher inlet temperatures.
Environmental Probe Mounting

Ideally in the path of cold air
Environmental Accessories

- Fire and smoke
- Water detector
- Vibration sensor
- Door open/close sensor
- Camera
Security Intrusion

- Network cards should be cyber security tested
- Monitor for physical intrusion
Lock Options

- Key lock
- Combination lock
- Electronic lock
Electronic Locks DC or POE Powered

- Powered by geared motors
- Master Emergency Key
- Connection to SPS

- HTTPS
- Syslog
- MS Active Directory, LDAP, RESTful API
- Web API
- Two-factor Authentication
- SNMP
Electronic Lock Access Options

- **PIN pad**
  - PIN input
  - Through RFID combible for two-factor authentication

- **Hand vein scanner**
  - Highest security level through hand vein detection

- **RFID (radio-frequency identification)**
  - 125 KHz frequency band
  - 13.56 MHz frequency band
  - HID, Mifare, Desfire

- **Finger print scan**
  - Biometric procedure protects from abuse

- **Touch display**
  - Authentication through entry at the touch display
  - Displays operation parameters like temperature, humidity

- **Remote**
  - Access over remote control
  - Versatile access possibilities
  - 5 V, 12 V, 24 V
SOFTWARE MANAGEMENT
Managing with Software

- Internal software
  - Web browser, command line
- Branch monitoring
- Building management software (BMS)
- Data center infrastructure management (DCIM)
- Remote monitoring services (cloud based)
Internal Web

- Web GUI
- Great for small number
- Limited reporting
- Email alarms
Internal Command Line

- Know as CLI (command line interface)
- Serial RS232
- Network Telnet / SSH
- Putty or SecureShell
Branch Monitoring

- Communicates over SNMP
- Power monitoring
- Alarms
- Phase balancing
- Reporting
- Trending
Building Management System (BMS)

• Monitor and control building systems
• HVAC, security, entry, fire, etc.
• Can tie in IT monitoring
• BACNET or SNMP
DCIM Overview

- Monitoring
- Port mapping
- Asset management
- Reporting and dashboard
- Capacity planning
- Change/workflow management
DCIM - RPDU Outlet View
DCIM - Rack Elevations
Remote Monitoring Service

- Cloud based
- Remote monitoring team
- Ideal for remote office / branch office rollouts with lack of technical expertise
- Monthly reports, dashboards and analytics
- Self install
POWER
Power

• Backup power (UPS)
  – Battery backup for power outages
  – Ensures power quality
  – Rack level or centralized

• Rack power distribution (RPDU)
  – Distributes power to equipment
  – Meters power
  – Controls power to devices
Determining Power Density

• Often referred to as KW of rack
• Could be identified as input plug type
• Calculated by adding total power draw of IT equipment + expansion capacity

Example: 3 phase 50 amp plug 14.4KW
How much power do I need?

- Power supply label rating
- Manufacturer spec sheet
- Measured rating use peak
Current (A) or Power (W)?

• Power supplies have current and watts ratings
• Current changes with voltage
• Simplified example: 480W power supply draws 4 amps at 120 volts or 2 amps at 240 volts
• Either can be used to size the load
Single Phase or Three Phase Power

• Usually determined ahead of time
• Three phase is generally used for higher power
BACKUP POWER (UPS)
Ten UPS Selection Criteria

1. Power environment: single and three-phase
2. Installation environment
3. Power load
4. Availability and battery runtime
5. Form factor
6. Scalability
7. Power distribution
8. Manageability
9. Operation and maintenance
10. Budget
UPS Form Factors

1. Desktop and tower
2. Wall-mount UPS
3. Rackmount Compact UPS
4. Rackmount UPS
5. Two-in-one rackmount / tower UPS
6. Scalable UPS
7. Large tower UPS
Difference Between VA and Watts

- Watts is related to apparent power (VA) using a ratio referred to as power factor (PF)
- Watts = VA * PF
- VA = Watts / PF
- Consider power supply power factor when sizing UPS
Plug Types

Select plug
Nine Major Power Problems

- Higher quality UPS address more problems
- Understand power quality concerns at location
Types of UPS Topology

- Standby
- Online
- Line-interactive
- Ferro resonant
## 0-3 kVA UPS

<table>
<thead>
<tr>
<th>Model</th>
<th>Features</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eaton 9PX &amp; 9SX</td>
<td>LCD Screen, Pure Sinewave, Network Slot, Load Segments</td>
<td>Online UPS</td>
</tr>
<tr>
<td>Eaton 5PX</td>
<td>LCD Screen, Pure Sinewave</td>
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<tr>
<td>Eaton 5P</td>
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<tr>
<td>Eaton 3S</td>
<td>Pure Sinewave</td>
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</tbody>
</table>

**Notes:**
- EBMs: Essential Backup Modules
- Outlet Meter: Monitoring and Recording of Power Consumption
5-6kVA UPS (208V output)

- 0.9 power factor
- 93% efficiency
- 5000/6000 VA models
- 3U rack/tower form factor
9PX 5 & 6 kVA Components

6 kVA EBM
• Extended battery module increases runtime by hours.

6 kVA PPDM
• PowerPass Distribution Module allows a step-down voltage to 120V to accommodate a variety of IT equipment. The PPDM also provides a maintenance bypass, which allows you to service or replace the entire UPS without powering down IT equipment.

5 kVA Transformer
• Provides 120V output through receptacles.
9PX 8 & 11 kVA UPS (208V output)

- 0.9 power factor
- 94% efficiency
- 8000/11000 VA models
- 6U rack height
- 28 percent more power versus competition
- Includes power module and EBM
New Battery Technology

**Safety benefits**
- Lithium phosphate battery chemistry is stable and safe
- Battery management system (BMS) actively monitors temperature and charge cycles
- Common vendor for battery and BMS improves integration and safety

**Installation benefits**
- Save money on battery replacement costs
- 40% weight reduction eases installation
- Shift your refresh cycle to be in line with your IT equipment

**Performance benefits**
- 2.5X longer life allows you to set it and forget it
- 6X faster charge improves recovery
- BMS provides up-to-date insight into battery performance

*Eaton 5P UPS with lithium-ion battery*

**By the numbers: 5P 1U 1500 VA UPS**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>VRLA battery</th>
<th>Lithium-ion battery</th>
<th>Lithium-ion benefit</th>
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</thead>
<tbody>
<tr>
<td>Battery life span</td>
<td>3-4 years</td>
<td>8 years</td>
<td>2.5X longer life</td>
</tr>
<tr>
<td>Recharge time (from 0% to 80% runtime capacity)</td>
<td>24 hours</td>
<td>4 hours</td>
<td>6X faster recovery</td>
</tr>
<tr>
<td>Battery weight</td>
<td>19 lb.</td>
<td>11 lb.</td>
<td>40% lighter weight</td>
</tr>
<tr>
<td>Battery replacement cost</td>
<td>$600*</td>
<td>$0</td>
<td>$0 OpEx expenditure</td>
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<tr>
<td>Warranty</td>
<td>3 years</td>
<td>5 years</td>
<td>2X warranty coverage</td>
</tr>
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</table>

*Battery and labor cost for two replacements*
Typical UPS Configuration

Traditional installation  Maintenance bypass
UPS Bid Specification
ROW OR POD DEPLOYMENT
Deploying Multiple Racks

• Row various lengths
  – Back or front of racks face each other

• Pod is a cluster
  – Often uses containment
Rows of Racks in a Data Center
THERMAL MANAGEMENT
Rack is the Key Point to Control Air Flow

**Rack Hygiene** – Determines the containment capability of the rack outside the u-space

**Five Airflow Fault Areas**

1. Under the rack
2. Left side of left 19” rail
3. Right side of right 19” rail
4. Above top U rack-mount space
5. Below bottom U rack-mount space
Key Challenges in Legacy Data Centers

- Bypass Airflow
- Temperature Stratification
- Re-Circulation
Thermal Management

- High-flow doors and maximized surface area
- Air dams
- Blanking panels
- Brushes, grommets, vertical blanking

Organize
Three Types of Containment

- Rack Based Containment
- Hot Aisle Containment
- Cold Aisle Containment
Real World Challenges - Lighting, Cabling and Power

- Rack-based containment allows for standard cable and wiring best practices
- Can be retrofitted in the field without interruption of processing equipment
POWER DISTRIBUTION
Distribution Schemes

• Panel board
• Floor standing power distribution unit
• Remote power panel (RPP)
• Busway
PANEL BOARD
Panel Board Distribution

- Mounted on wall
- Distributes power to PDU in racks
- Generally under raised floor or conduit overhead
FLOOR STANDING PDU AND RPP
Floor Standing PDU

• Located around data center
• Can feed power to more than one row
• Typically raised floor but can support conduit over head
Remote Power Panel

- Located at the end of the row
- Typically features two or four 42 position circuit breaker panels
- May include branch monitoring
Bid Specification

• Sample bid spec
BUSWAY
Busway

- Overhead power distribution
- Bus plugs twist into busway
- Easy to reconfigure
Summary

• Physical and power infrastructure is just as critical as cabling
• Increasing demands are being placed on data center professionals to understand all aspects of the data center
• Using guide specs combined with general knowledge will ensure an efficient design