Power Monitoring in the Data Centre

Fixed or Wireless

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ANIXTER INTERNATIONAL
Agenda

- Energy Consumption
  - Case Study
- Reasons to Monitor
  - Power Monitoring
  - Environmental Monitoring
- Asset Tags
Why should we be concerned?

- PUE is the metric used to determine the energy efficiency of a data center
  - Divide the amount of power entering a data center by the power used to run the computer infrastructure within it
Data Center Energy Consumption

- Improved operation
  - 20% reduction, estimated savings by 2011:
    - 23–74 billion kWh, on yearly in electrical cost
    - 11 MMT CO₂ reduction

- Best practices
  - 45% reduction

- State of the art
  - 55% reduction

Source: EPA Report EPA (56)
Power Consumption of Computing Equipment

Total world energy use rises from 495 quadrillion (170TWh) British thermal units (Btu) in 2007 to 590 quadrillion Btu in 2020 and 739 quadrillion Btu (254TWh) in 2035.

Rising Data Centre electricity consumption projected:
- Western Europe: 56 TWh in 2007, rising to 104 TWh in 2020

European Code of Conduct

One central base load power plant produces about 7 TWh/year
Data Center Cabling – Best Practices

• Monitor and control performance
  – Monitoring tools to capture performance, temperature and power in data center
  – Measure server temp in real time
  – Create historical graphs for trends
  – Departmental billing based on energy usage instead of RU space
Data Center – Best Practices

• Use effective economizers:
  – Water side, outside air to cool chilled water
  – Air side, outside air directly into data center
Data Center – Efficiency Tactics

• Virtual servers, consolidation and storage:
  – Server virtualization
    • For example, VMware and Microsoft
  – Consolidate equipment – use blade instead of rack servers
    (shared fans and p/s)

• Utilize CPU management feature:
  – Optimize power consumption based on CPU utilization
  – Lowers processor power states when peak performance is not needed
  – Reduces power consumption without compromising processing capability

• Storage:
  – Tiered – only use high-speed drives where applications need immediate response
  – Consolidated – large disk drives, slow speed more efficient warrant use with volume
• Products:
  – High-efficiency UPS systems and distribution
  – High-voltage rack PDUs and power strips
  – IT equipment – power cords
  – Precision in-row air cooling options
  – Augmented air and water delivery systems and ducting systems
  – Monitoring and measurement tools:
    • Thermal cameras
    • Modeling software
    • Detection systems
  – Rack accessories:
    • Blanking panels
    • Cable management
    • Rear door exhaust systems
A Case Study Corporate Data Center Temperature

Environment
• Designed pre-standards
• Not a true hot and cold aisle layout
• Flooded room with cooling
• Low density per enclosure

Contours of Static Temperature (°F)
A Case Study
Corporate Data Center

Return airflow pattern
• Long return route
• No separation between cold supply and hot return air
• Air mixing

Inefficiencies
• Hot and cold air mixing
• Fan speed
• Cold supply air distance traveled
• Overall layout
A Case Study
Corporate Data Center

Airflow under floor
- Sufficient under floor velocity
- Restriction points
- Considerable travel distance
- Static pressure increases as velocity decreases
A Case Study
Simple Recommendations

Recommendations
• Best practices
  – Implement hot and cold aisle layout
  – Install blanking panels
  – Improve cable management
• Air mixing and distance
  – Install air return grates above hot aisles
• Cooling
  – Remove production CRAC unit

Results
• Best practices
  – Increases airflow optimization
  – Minimizes air mixing
  – Promotes front to rear airflow
  – Reduces air recirculation within enclosure
  – Removes airflow restrictions
• Air mixing and distance
  – Reduces hot exhaust air recirculation
  – Improves CRAC Delta T
• Cooling
  – Increases kWh savings

Simple improvements - measured results: 12% reduction in yearly kWh
Estimated ipAssured Power Savings

Kilowatts per hour/per year

£150

15% IP-CLASS 1+

£200

£250

45% IP-CLASS 5+

£300

45% IP-CLASS 10+

45% IP-CLASS 10+

 Thousands

Power Consumption Cost Will Vary Based On local Electricity Rates
European Code of Conduct on Data Centre Energy Efficiency

2010 Best Practices
Recommendations 4 Categories

Entire Data Center
New Software
New IT Equipment
Build or Retrofit 2010 onwards

Code of Conduct on Data Centres Energy Efficiency
Version 2.0

Bicsi
Reasons to Monitor

- Air flow from servers is blocked; cable support arms become heat sinks.
- Open spaces allow hot air to flow through cabinet and mix with cooling air.
The Data Centre Environment

- Amps
- Volts
- KW/h - KVA
- Temperature
- Humidity
- Smoke
- Water
- CCTV
- Door contacts
- Door locks
- Dry contacts
- UPS
- HVAC
Monitoring - Power

- Why monitor (and manage) power?
- Capacity Planning
- Departmental Charging
- Phase balancing
- To Reboot
- To facilitate
  - Alerting
  - Reporting
  - Trend Analysis
- To reduce risk
Intelligent Power Strips

- Power Strips
  - Built in electronic measuring circuits to monitor; Voltage, Current, Frequency, kVA, kWHrs.
  - Measuring circuit powered from monitoring unit.
  - Choice of Zero-U or 19” Form factors.
  - 16A or 32 Amp feed cables terminated with EN 60309-2 Plugs (16A / 32A 230VAC) (63Amp also available).
  - Choice of outlet sockets:
    - EN60 320 C19 Sockets (16A 250VAC)
    - EN60 320 C13 Sockets (10A 250VAC)
    - BS1363 (UK13A) Sockets (13A 250VAC)
    - CEE 7/4 Shuko (16A 230VAC)
    - Any combination of above socket types subject to physical size constraints.
  - Other options:
    - fused or fused + indicator per outlet.
    - Circuit breaker per power strip / circuit.
    - Relay control of each outlet On/Off.
    - Sequenced Powering of outlets
In Line Power

- In Line Power Monitoring – typically used to monitor power where equipment requires its own dedicated 16Amp or 32Amp power feed.
- Applications include SAN storage devices and Main Frame Equipment
Non Invasive Monitoring
Example of Configured Cabinet

- Connecting Cables
- Processor
- Intelligent power strips. Individually fused with indicators
- Humidity Sensor
- Temperature Sensors
- Door entry keypad, proximity card
- Solenoid & contacts
- 32 Amp Commando’s
Rack Level Power Monitoring

- Remote power monitoring and metering of current (amps), voltage, power (kVA, kW) and energy consumption (kWh)
- Capable of ISO/IEC +/- 1% billing-grade accuracy
- Environmental monitoring (up to 16 sensors)
- Power information from individual outlets, lines and circuit breakers
- Remote reboot of unresponsive devices
- User-configurable, outlet-level delays for power sequencing
- Alerts via SNMP v2 and v3 TRAPs, SETs, GETs, email and syslog
- Outlet grouping over IP within the same PDU and across multiple PDUs
- Local power monitoring via LED display of voltage and current at both the line and circuit level
- Supports HTTP, HTTPS, SSH, Telnet and SNMP
• Monitor critical data points
  – Hot spots
  – Relative humidity
  – Water leaks
  – Smoke
  – Power usage
  – Unauthorized access
Wire-Free Environmental Monitoring Sensors

• Real-time monitoring data:
  – Temperature
  – Humidity
  – Door Position
  – Dry Contact
  – Fluid Detection

• Once installed:
  – Policy based threshold and alerting allows for proactive notification
  – Architecture is extensible, expandable, scalable and secure
Environmental Tag Deployment Options

• Rack Deployment Options:
  – Single or Multiple Sensors per Rack:
    • Single tag per rack for minimal coverage
    • Three tags per rack (top, middle, bottom) for maximum coverage – ASHRAE Standard
    • Door Switch Tag
  – Multiple Mounting Options:
    • Enclosures with Doors:
      – Mount with cable tie to front inside or outside of front rack door
      – Mount with adhesive
    • Enclosures without Doors
      – Mount with cable tie or adhesive to front of rack frame (left side or right side) of u-mounted equipment.
    • Room Walls
      – Adhesive backing allows tags to stick to almost any surface
      – Spot checks, remote locations
Infrastructure

Fixed Wireless Reader
- Real Time Inventory
- Lives on the IP Network
- Wired, Wireless and PoE models

Mobile Reader
- Real Time Mobile Inventory
- Blue Tooth Connectivity

IT Closet Reader
- Provides Remote Closet (IDF/MDF) Monitoring
- Lives on the IP network
- Asset and Environmental Sensors
- Easily mounts in top U of data racks
Security Monitoring

- Part of any solution is security
- Protecting any suitable area
- Proactive rather than Reactive
- Perimeter detection
- Infrared solutions
- Deter and Detect
- Linked to other systems
Asset Tracking

Location Engine

Web Services

Asset Management Software

Rack Readers & Tags

Zonal Readers & Tags

Asset Tracking and Physical Threat Monitoring Sensors
Asset Manager - Key Features

• **Web Based User Interface:**
  – Simple to use
  – Requires no browser plug-ins

• **Fully Customizable Asset Database:**
  – Advanced graphical editor eliminating the need for costly custom development services

• **Asset Life Cycle Management:**
  – Tag to asset association
  – Asset searching, reporting, and graphing
  – Asset alarming via threshold and alerting

• **Open Architecture:**
  – IBM Maximo, Tivoli Monitoring
  – Microsoft BizTalk, HP Asset Center
Zonal for Data Center - Example

- Delivers
  - Real time inventory
  - Zone or area level location tracking

- Ideal for data centers with open and closed racks
  - 4 post cabinets
  - 2 post racks
Asset Manager – Example Data Center Deployment

Example Output:
Server 27 is located in Rack 48, which is located in Building 1.
Software Management

- Operational, Data Capture & Alerting Software
- Simple and effective, designed to complement more substantial tools such as HP Openview
- Real-time alarm monitoring
- Centralised event logging
- Rack view
- Thermo graphic view
- Enhanced asset tracking
Monitoring Recommendations

• Locate sensors in appropriate locations (ASHRAE & The Uptime Institute)
• Integrated battery backup
• Alert notification capability that delivers across multiple media
  – E-mail
  – Pager
  – Voice message on phone line
  – SNMP traps
Management and Monitoring Solutions Summary

• The need to effectively manage and monitor the network from Layer 1 to Layer 7 will continue to increase
  – Regulatory Compliance
  – Additional Security
  – Maintenance
  – Asset management

• Organizational uptime and redundancy requirements will dictate the level of management and monitoring required
Summary

• Data Center owners need more information
  – Temperature and Asset management
  – Power consumption per rack or outlet

• Why?
  – Control the environment within the Data Center
  – Reduce power consumption through virtualisation
  – Improve the Power Usage Efficiency (PUE)

• Sources of Information
  – The Green Grid
  – Code of Conduct on Data Center Efficiency
THANK YOU

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