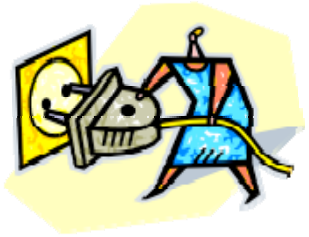
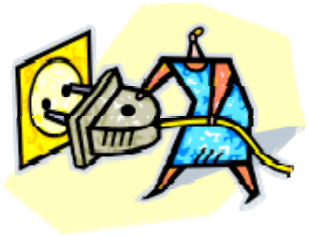


DOE Best Practices Workshop
Power Management
San Francisco, Sept. 28-29, 2010

Facility Metrics

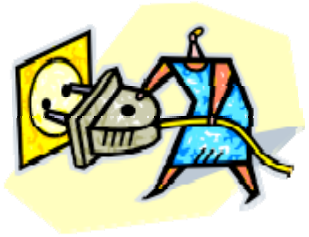
Metering and monitoring the computer center

Breakout Report



Breakout participants

Nicholas Nagy (Lead)
Anna Maria Bailey (Co-lead)
Bill Allcock
Marc Berman
Susan Coghlan
Thomas Davis
Sergi Girona
Sander Lee
Josip Loncaric (Note taker)
Richard Rivera
Jim Rogers
David Skinner
Erich Strohmaier



Experience
Novel / Interesting Approaches

Automated monitoring and control particularly beyond just the room (utilities, applications, weather, etc)

OSISoft – a form of “secondary bus” which aggregates data protocols from rack, facility, etc.

Wireless sensor networks for data center monitoring

Wireless sensor net in a secure environment

Methods of automatic power control

- core cycling, clock modulation,
- at what scale (core, node, job, rack, etc)

Best Practices in Facility Metrics

Facility Monitoring and control

- Metering (at what level?; cost vs. benefit)

Free cooling / automated control systems

Calibration / Maintenance of sensors

controlling cold air / hot air mixing (hot aisle/cold aisle, chimneys, containment)

Separate types of equipment (tape vs. disk vs. CPU) by operating environments

Meter / adjust Power Factor

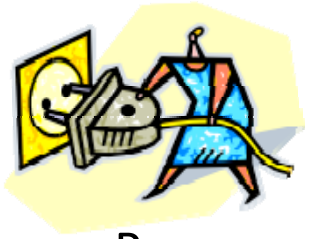
Consider separating equipment by power density and space density

Baseline your data center (all sensor streams, temperature, humidity, flow, pressure, power)

Strategic placement of sensors (right place, number, quality, type)

Be aware of safety issues that influence these practices (e.g. aisle containment could block fire sprinklers, high voltage, high current, leak sensors for water cooling systems)

Put metering / monitoring requirements in RFPs



Gaps Looking Forward to New Systems

Power monitoring to the node level

- what about net, disk, etc..
- possibly lower (memory, core, fans; core power down, data movement expensive)
- use this for decision making (scheduling, etc)

Ontologies / standards for power related data?

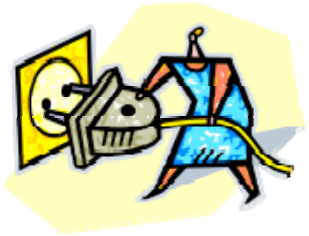
- allow easier software development

Power swings due to variable job load

Auxiliary equipment power metering in the rack, device, cooling system

Correlation of power quality to facility, hardware, and application issues.

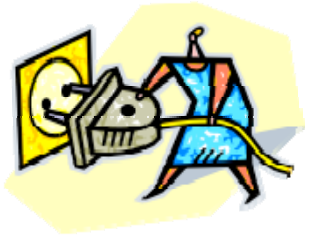
Analytics on the monitoring data (trends, correlations, validation, empirical facility models, expert systems, neural networks, complex systems)



Evolve or start over for future systems?

(is there a natural evolutionary path for this area to support future systems – or are there issues and projected requirements such that a complete new start is needed)

No need to start over, but evolve, expand, and integrate learning from other industries.



Issues shared with large commercial centers

There is significant overlap

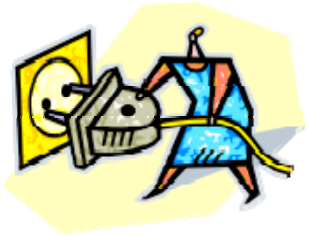
We run unique architectures, which could make it harder for us due to more complexity and standards (IPMI as an example) possibly not applying

Commercial often has much higher availability requirements than we do.

Commercial is better at measuring usage because they have real costs associated with it.

Opportunities for collaboration

- raising data center temperatures
- hot aisle / cold aisle arrangements
- standards
- Building automation systems



- Hardware/facility/system interfaces to influence

Vendors need to publish accurate and realistic temperature limits

- optimal, warnings, shutdown

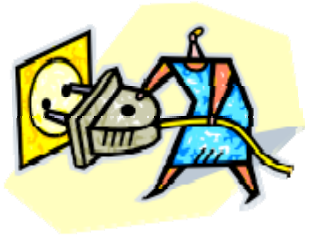
Sensors with the appropriate quality and engineering as the device itself and commensurate with the impact of a failure.

Standardized Monitoring

Open, public, standards and protocols (PAPI for power, SMI-S)

Improved standards based security in the metering / monitoring systems

Interoperability of the various systems (hardware, facility, system, utilities, etc)



Status of (de facto) standards

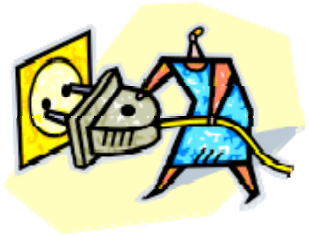
Metering fabrics (modbus, BACnet) have no concept of security.

Applications also need to integrate into standard security systems (PAM, LDAP, etc).

Are there any standards emerging from SmartGrid?

ASHRAE standards have broadened their limits significantly

Building automation standards (OBIX, LonTalk, BACnet) need scalability improvements to meet HPC needs.



Other key findings

Must be cognizant of the impact that monitoring has (some IPMI implementations are an NMI)

DOE directives (DOE 430.2b) to reduce consume less energy and water and reduce greenhouse gas emissions drives the need for advanced metering and there are possible credits for installing advanced metering.

Learn from current state of the art facilities; Don't reinvent the wheel.

Install metering for that renewable you should be using