IBM Technology and Solutions
Jan Janick
IBM Vice President
Modular Systems and Storage Development
Power and cooling are complex issues
There is no single fix. IBM is working on this issue for its clients on every level – we are delivering the most comprehensive power and cooling strategy available.
Running Out of Power & Cooling – what does it mean?

Electrical and Cooling planning values can make the difference between either having adequate capacity or running out of power.

• **Nameplate vs. Maximum Measured Power Consumption**
  Issue compounded by lightly loaded systems designed for worst case configurations and work loads.
  How to “right size” the power & cooling systems?
  Limitations:
  • Derating, redundancy (2n+1, n+1), & efficiency at load points
  • Main transformer (and substation)
  • UPS systems
  • PDU – power panels, pole positions

• **High Density Blade Products**

• **Data Center Cooling Capacity: Chiller Plant & Air Handlers**
How is the problem showing today

Gartner Data Center Conference – 12/05
- Attendee Polls

1) Over 50% of poll respondents cited Excessive Heat or Insufficient Power as their key issue

Question: What is the greatest facility problem with your primary data center?

- Excessive Heat
- Insufficient Power
- Insufficient Raised Floor Area
- Poor Location
- Excessive Facility Cost
- Other

2004 n=112
2005 n=182

2) 15% respondents cited specialty cooling solutions

Question: What is your primary source of cooling? n=180

- Centralized cooling plant only 29%
- Distributed cooling (CRAC units) 57%
- CRAC units plus specialty cooling for hot spots 12%
- Specialty cooling only (water cooled; rack enclosure, etc.) 3%

Source: Gartner Data Center Conference, 12/05
http://www.gartner.com/2_events/conferences/lsc24.jsp

- 1) Datacenter heating up because power in = heat out.
- 2) Running out of power capacity from the utility grid.
- 3) Density requires White Space / drives Lack of Space

- Cost of electricity – rising prices coming on top of the TCO

- Current issues relating to power and cooling intensifying in the near term

  - By 2008, 50% of current data centers will have insufficient power and cooling
Systems Technology:
IBM addresses the Power / Cooling Challenge

Virtualization & Management Systems
- Server, Storage, and Networking

Power and Cooling Advances
- BladeCenter Package Enhancements
  - IT equipment sharing power and cooling subsystems
- Improving Power Supply/Regulator Efficiency
- Additional function in PDU’s
- Auxiliary Cooling (Rear Door Heat Exchanger)

Low Power and dynamic mgmt modes
- Intel, AMD
- Power
- Mainframe

New Technologies
- Reduce Leakage current with new technologies such as nano technology and vacuum insulation.
Technology and Processors

- Technology
  - ‘Airgap’ Technology in chips to reduce power by 15% or increase performance by 35% at current power levels.

- Processor & Chips
  - Additional Power Management modes
    - Max Power Save
    - Performance Aware Power Save
    - Power Capping
    - Turbo
    - Acoustic Optimization
    - Traditional
Cooling Advances: IBM Cool Blue Portfolio

- Energy efficient cooling systems utilizing Calibrated Vector Cooling
- Supplemental cooling systems – Rear door heat exchanger
- IBM Director – Power Executive: Thermal trending
- Intelligent PDUs: Remote thermal sensors
- Power/Cooling Configurator
Power Advances: Efficiency

- New Power supplies must be designed to exceed the EPA, 80Plus, or Climate Savers requirements.
  - Greater than 80% Efficiency for any load greater than 20%.
  - Greater weight will be given to 10-50% load range over the 100% load in Design & Purchase Decisions
    - Redundant system typically run at less than 50% of load
    - Typical Customer configurations run in 10-30% range

### Power Supply Efficiency

![Power Supply Efficiency Graph](image_url)

- **Latest PS**
- **Proposed Silver Level**
- **Proposed Gold Level**
- "Typical PS"

Historical Power Supply
Design Focus (100% Load)

Increased Emphasis Will Be Placed on 20-50% Load Range
**Power Conversion Efficiency Perspective**

![Typical 1U Server Power Usage](image)

Based on today’s technology and system trends, what usually happens is:

1. **AC/DC @90%**  →  500W **@85%**  →  **425W** Delivered to devices

2. **AC/DC @95%**  →  **447W** **@95%**  →  **425W** Delivered to devices

**~15% reduction of input power**

**Equivalent input power, driving a higher system load:**

- **AC/DC @92%**
- **AC input power**
- **512W** **@90%**

**Efficiency matters: but won’t solve all the issues**
Virtualization: How it helps energy savings

- Typical Intel type server utilization is below 30%
- Virtualization can increase utilization and unlock new processing capability for scale up and scale out without adding to power at the rack level

![Graph showing AC watts consumption](attachment:graph.png)
Virtualization takes power efficiency to the next level

- Virtualization creates largest impact to Power/cooling in Data Centers
  - Virtualization improves server and storage utilization which:
    • Reduces the number of servers and therefore, Space, Power, & Cooling required
    • Allows for targeted thermal solutions for efficiencies
    • Allows for more efficient power distribution, backup, and regulation
  - Enables dynamic resource management for
    • Deployment and Operational Optimizations

- Some examples
  - Base Consolidation
  - Policy Based Consolidation
  - Policy Based Provisioning
Energy Management Example
Server Consolidation Conserves Energy

Total Power 8KW

Server consolidation exploiting virtualization is a very effective tool in reducing energy costs

Total Power 4KW
Virtualization / Consolidation Example

- Customer migrated from a competitor’s 1U to IBM consolidating and virtualizing

<table>
<thead>
<tr>
<th></th>
<th>“other” Server</th>
<th>BladeCenter</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average power per server</td>
<td>300W</td>
<td>250W</td>
<td>17% less</td>
</tr>
<tr>
<td>Number of servers</td>
<td>1000</td>
<td>266</td>
<td>70%+ less</td>
</tr>
<tr>
<td>Data center wide power input</td>
<td>300KW</td>
<td>66.5KW</td>
<td></td>
</tr>
<tr>
<td>Total power cost</td>
<td>$394,200US</td>
<td>$87,381US</td>
<td>77% less</td>
</tr>
</tbody>
</table>

- 70% less servers to manage
- 70% less licenses to buy if consolidating

- 77% less power cost but also less power input
- Many data centers today are simple out of power
  - UPS limit
  - PDU limits
  - City/Municipal limits
Management Systems

Enterprise Management

Policy Based Management

Platform Management

Planning Tools

Tivoli Enterprise Management:
- ITM Monitoring
- CCMDB Extensions and TDW
- ITUAM Accounting

Policy Automation:
- Power-aware Deployment
- Request based Deployment
- Power-Performance Management

Systems Director Additions
- Power Executive (Power & Thermal Support)
- Measure, Monitor, Trending (need a sensor network)
- Control and Capping (what can be learned from low power designs)

Energy Capacity Planning Tools
- Online planning tools that include Power and Thermal capacities
For systems without built-in power meters, we will gather information from supporting devices such as the IBM DPI PDU+.

<table>
<thead>
<tr>
<th>Group</th>
<th>Outlet</th>
<th>System Name</th>
<th>Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J1</td>
<td>System A</td>
<td>UNIX System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>J2</td>
<td>System B</td>
<td>Windows 1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>J3</td>
<td>System C</td>
<td>Windows 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>J4</td>
<td>System D</td>
<td>Linux 1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>J5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>J6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>J7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>J8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>J9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>J10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>J11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>J12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Energy Management Policy Example

Workload Migration
*Enables Dynamic Server Consolidation*

Use of hibernation, powering off servers, and other low power states in combination with other workload balancing and provisioning tools can provide a valuable tool in management of Power and Thermal issues.

- **Automate Energy Control**
  - Policy based automation
- **Control Energy Consumption**
  - Consolidate workloads to reduce
THANK YOU

Contact information

Jan Janick
VP Modular Server and Storage Development
jianick@us.ibm.com
919-543-5051
Copyright information

© Copyright IBM Corporation 2007

IBM Global Services
Route 100
Somers, NY 10589
U.S.A.

Produced in the United States of America
10-07
All Rights Reserved

IBM and the IBM logo are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both.

Other company, product and service names may be trademarks or service marks of others.

Use of the information herein is at the recipient's own risk. Information herein may be changed or updated without notice. IBM may also make improvements and/or changes in the products and/or the programs described herein at any time without notice.

References in this publication to IBM products or services do not imply that IBM intends to make them available in all countries in which IBM operates.