Power-Aware Database Disk Storage System

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Motivation

- Data centers consume considerable amount of energy (61 billion kWh, 45 billion US dollars in 2006).
- The major consumer of the data centers is the database disk storage component (25%-35%) called Disk Farm.
- The Green Computing Movement: Dynamic Power Management (DPM) techniques are commonly used for saving energy in disks storage systems.
Dynamic Power Management

• Key idea:
  ✓ Most frequently accessed data (hot data) stored on hot disks
  ✓ Transition other disks into sleep mode (cold)

• DPM algorithms determine dynamically when
  (1) the disk should be transitioned to cold state
  (2) certain data should be stored in particular hot disks
Hard Disks Specifications

<table>
<thead>
<tr>
<th>Mode</th>
<th>Rotation Speed (RPM)</th>
<th>Power (W)</th>
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</thead>
<tbody>
<tr>
<td>Active</td>
<td>12000</td>
<td>39</td>
</tr>
<tr>
<td>Stand By (sleep)</td>
<td>3600</td>
<td>4.15</td>
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Experimental Simulation Results

• $F$: hot data spread out factor, $\lambda$: workload intensity
• $F=1$: the worst performance vs. the most power saving
• $F=10$: the best performance vs. the worst power saving
• Mid-range $F$: reasonable power-performance trade-off

✓ Main Green Result: A 25-72% energy savings can be achieved with little performance degradation.