Energy Efficiency Considerations for HPC Procurement

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Cray XC System PM Capabilities

- **Blade/Node-level power/energy data collection at 10Hz**
  - + Accelerator data captured on blades with MIC GPU hardware installed

- **Cabinet-level power/energy data collection at 1Hz**
  - Includes data for Blower Cabinets

- **Power management database (PMDB) on the SMW**
  - Cabinet-, blower-, blade-, and node-level power/energy data at 1Hz
  - App data: Job-Id, User-ID, start-time, stop-time, ..., and NID-list
  - PostgreSQL database

- **Node-level power/energy and related data into /sysfs at 10Hz**
  - /sys/cray/pm_counters:
  - RUR energy-plugin, CrayPat, PAPI, and 3rd party tool access
Cray XC System PM Capabilities (cont)

- **System Environmental Data Collection (SEDC)**
  - Voltage, current, temperature, fan-speed, …
  - Data saved to Database*, or flat-files on Cray SMW

- **Cray Advanced Platform Monitoring and Control (CAPMC)***
  - Platform monitoring and control API for 3rd party WLM integration
  - Monitoring and control from select service nodes
    - Node power: on | off, system-level and node-level monitoring
    - WLM (Workload Manager) directed system-, node-, job-level power capping

- **Turbo-boost limiting***
  - Boot time ability to enforce max turbo boost
  - Save energy at large scale due to variation in achieved max turbo boost…

* New Feature released in Oct 2014
2014 Feedback, General impressions

- A lot of great material
  - If you have not read it, you should!

- Supportive use cases for each level of monitoring requested would be helpful
  - Motivate customers to include details in their procurement documents
  - Justify vendor investment
2014 Feedback, Section 2

- Nice write-up with respect to reported vs. internal sampling
- Perhaps guidance with respect to continuous vs. on-demand data collection would be useful
- At the mandatory (lowest recommended) rate, continuous data collection on a large system would create a tremendous amount of telemetry data

<table>
<thead>
<tr>
<th>Cabinet Count</th>
<th>Nodes/Cabinet</th>
<th>Components / Node</th>
<th>Bytes/sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>192</td>
<td>4</td>
<td>24</td>
</tr>
</tbody>
</table>

(Note: Actual Database size / growth rate likely much higher…)

<table>
<thead>
<tr>
<th></th>
<th>Bytes/Second</th>
<th>Bytes/Day</th>
<th>Bytes/Week</th>
<th>Bytes/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabinet Energy</td>
<td>2,400</td>
<td>207,360,000</td>
<td>1,451,520,000</td>
<td>75,479,040,000</td>
</tr>
<tr>
<td>Node Energy</td>
<td>460,800</td>
<td>39,813,120,000</td>
<td>278,691,840,000</td>
<td>14,491,975,680,000</td>
</tr>
<tr>
<td>Component Energy</td>
<td>1,843,200</td>
<td>159,252,480,000</td>
<td>1,114,767,360,000</td>
<td>57,967,902,720,000</td>
</tr>
<tr>
<td>Totals</td>
<td>2,306,400</td>
<td>199,272,960,000</td>
<td>1,394,910,720,000</td>
<td>72,535,357,440,000</td>
</tr>
</tbody>
</table>

- Likely more than four components / nodes.
- Way more if you monitor each power rail!
New this year

- Not clear that external reporting at 1Hz is well justified
  - Detailed use case for 1Hz data is needed
  - Perhaps tables with mandatory, important, and enhancing external reporting frequencies like used in section 2

- Mandatory external reporting at 1 sample per minute is a more justifiable target
Backup

● 2013 Presentations from AMD, Cray, IBM, and Intel
  ● [http://eehpcwg.lbl.gov/sub-groups/equipment-1/procurement-considerations/procurement-considerations-presentations](http://eehpcwg.lbl.gov/sub-groups/equipment-1/procurement-considerations/procurement-considerations-presentations)
Additional Resources

“Monitoring and managing power consumption on the Cray XC30 system”

- Cray S-0043-72

“Managing system software for the Cray Linux Environment”

- Cray S-2393-52xx