Cray Advanced Platform Monitoring and Control

CAPMC, CUG 2015:
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Introduction

● Overview of CAPMC
  ● Availability
  ● Functionality
  ● Architecture

● Applets
  ● Quick walkthrough of the API

● Near-term roadmap for CAPMC
  ● In-band controls
  ● Additional “Platform” use cases
  ● As always, roadmap is subject to change…
Cray Advanced Platform Monitoring and Control
- Cray SMW 7.2.UP02 and CLE 5.2.UP02, release in Oct-2014
- XC30 and XC40 systems

Cray Advanced Power Platform Monitoring and Control
- Use of CAPMC planned for much more than just power

1st CAPMC release enables
- Power-aware scheduling and resource management
CAPMC Functionality

- Access to system- and cabinet-level power data
- Access to node-, job-, and app-level energy data
- Control of node-, job-, and app-level power capping
- Control to power on and off idle nodes

Cray supplying monitoring & control capabilities

Enabling WLM partners to innovative & manage policy
lower case “capmc” is the Python command line tool
CAPMC Architecture

- **Python CLI (capmc)**
  - Clients installed on select service nodes
  - Enable integration with 3rd party WLM software
- **REST API**
  - JSON data interface(s)
  - Nginx (pronounced engine-x) web server
- **Access control and security**
  - SSL & X.509
- **SMW Backend**
  - Implementing out-of-band monitoring and control functions
CAPMC Applets: System-Level Monitoring

- **get_system_power [-s start_time] [-w window]**
  - Returns system-level power data
    - Minimum, average, and maximum power for the requested time window

- **get_system_power_details [-s start_time] [-w window]**
  - Returns cabinet-level data for all cabinets in the system

**Time Format: 'yyyy-mm-dd hh:mm:ss'**

**Time in seconds**
CAPMC Applets: System-Level Monitoring

- **get_system_power [-s start_time] [-w window]**
  - Returns system-level power data
  - Minimum, average, and maximum power for the requested time window

- **get_system_power_details [-s start_time] [-w window]**
  - Returns cabinet-level data for all cabinets in the system

Use Case: (From our PM workshop earlier this week)
Video playback 40X real time, 24 cabinet system running HPL
CAPMC Applets: Node-Level Monitoring

- **get_node_energy_stats** [-s start_time] [-e end_time] \
  [--nids nid_list] [--apid apid] [--jobid job_id]
  - Returns statistics for node-level energy (fixed size response)

- **get_node_energy** [-s start_time] [-e end_time] \
  [--nids nid_list] [--apid apid] [--jobid job_id]
  - Returns node-level energy data (one record for each node)

- **get_node_energy_counter** -t time [--apid apid] [--jobid job_id] \
  [--nids nid_list]
  - Returns raw accumulated energy counter data (one record for each node)
  - Multiple calls needed, raw counters used for delta calculations

Given an apid, CAPMC can use start_time, end_time, and the nid_list from the PMDB
CAPMC Applets: Node-Level Monitoring

- `get_node_energy_stats [-s start_time] [-e end_time] \
  [-nids nid_list] [-apid apid] [-jobid job_id]`
  - Returns statistics for node-level energy (fixed size response)

- `get_node_energy [-s start_time] [-e end_time] \
  [-nids nid_list] [-apid apid] [-jobid job_id]`
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  - Returns raw accumulated energy counter data (one record for each node)
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WLM Use Case:
- Supporting interactive user queries on power/energy of their job(s)
- Tracking app-, or job-level power/energy to enable dynamic power scheduling

Additional use cases covered in our paper
CAPMC Applets: Node Power ON | OFF

- **node_on --nids nid_list**
  - Turn-on nodes and boot Linux making them ready to run jobs

- **node_off --nids nid_list**
  - Shutdown Linux and power off the nodes

- **node_rules**
  - Returns information to the WLM w/respect to node on/off operations
  - Allows system admin to establish constraints

- **node_status [--nids nid_list] [--filter 'opt|opt|opt|...']**
  - Returns current status for requested nodes
  - Allows WLM to poll for status of nodes it has powered on/off
  - Filters: show_all, show_off, show_on, show_halt, show_standby, show_ready, show_diag, show_disabled

**nid_list:** ‘1,3,9-11, 100-300'
CAPMC Applets: Power Capping

- **get_power_cap_capabilities [--nids nid_list]**
  - Returns power capabilities per node-type, for requested nodes

- **get_power_cap [--nids nid_list]**
  - Returns current power cap settings, one record per node

- **set_power_cap --nids nid_list [--node watts] [--accel watts]**
  - Set power cap settings
CAPMC Applets: Power Capping

- `get_power_cap_capabilities [--nids nid_list]`
  - Returns power capabilities per node-type, for requested nodes

WLM Use Case:
- Power capping at job launch
- Dynamic power capping at application, job, or system-level
  - Adjust power cap up/or down within limits in `get_power_cap_capabilities`
  - Respond to external site conditions or changes in workload priorities
- Scheduling for system power/cooling limitations
  - Power capping as a way to implement power as a consumable resource
CAPMC Roadmap

● Proposed new in-band features
  ● Dynamic c-state limiting
  ● Dynamic p-state limiting

Working with ACES on new in-band controls enabled by the HPC PowerAPI

● Proposed new “Platform” controls
  ● Configuration controls for future blades and processors
  ● Enable WLM to configure nodes to match job-level requirements
  ● Support WLM orchestration of hardware reinitialization
    ● As required to activate requested changes
Q&A

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Additional Resources

Man Page

- capmc (8)
  - http://docs.cray.com/cgi-bin/craydoc.cgi?mode=Show;q=;f=man/smwm/72/cat8/capmc.8.html

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

- Cray S-0043-72
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