Cray® XC™ Advanced Power Management (APM) Updates

Steven Martin, Greg Koprowski, Dr. Sean Wallace
Cray Inc.
{stevem, gkoprowski, swallace}@cray.com

Please hold questions for the end of the presentation!
Cray XC APM Updates

● This will be a quick update on XC APM
   ● Monitoring and control of power and energy is important in HPC
   ● The Cray APM team wants to promote open communication

● This presentation will cover the following
   ● Compute blades supported on the Cray XC50 platform
   ● Cray XC50 compute blade APM features
   ● Cray XC50 blade featuring Intel® Xeon® Scalable processors
   ● Cray Power Management Database (PMDB) updates
   ● Cray XC50 APM usage examples
Compute Blades on the Cray XC50 Platform

- Cray APM is supported on all XC compute blades!
- The Cray XC50 supports the following blade types
  - NVIDIA® Tesla® P100 PCIe GPUs
  - Intel® Xeon® Scalable processors
  - Cavium ThunderX2™ processors
Cray XC50 Compute Blade APM Features

**Power and energy monitoring**
- Advanced out-of-band (OOB) blade level monitoring
  - Total node, aggregate CPU and Memory, power and energy
- Publishing power and energy data OOB into PMDB
- Publishing power and energy data in-band /sys/cray/pm_counters

**Power and energy control**
- Node level power capping
- P-state and c-state limiting
- Cray advanced platform monitoring and control (CAPMC)
Cray XC50 Blade with Intel Xeon Scalable Processors

- Four 2-socket nodes per blade
- Eight DDR4 memory slots per socket
  - Six memory channels per socket
- Varying core counts and TDP up to 165 watts.
Cray SPDC with Intel Xeon Scalable Processors
Cray XC50 Vicor VCORE Power Solution

Intel Xeon Scalable Processors

1/8th Brick, V(IN) = 52V, V(OUT) = 12V

ECB: LM5066i

Input (52 VDC)

Socket 0: CPU Vcore
VR13 SVID + PMBus
V(IN) = 52V

Socket 0: CPU VCCSA
VR13 SVID + PMBus
V(IN) = 12V

Socket 0: CPU VCCIO
VR13 SVID + PMBus
V(IN) = 12V

Socket 1: CPU Vcore
VR13 SVID + PMBus
V(IN) = 52V

Socket 1: CPU VCCSA
VR13 SVID + PMBus
V(IN) = 12V

Socket 1: CPU VCCIO
VR13 SVID + PMBus
V(IN) = 12V
Cray XC50 Vicor VCORE Power Solution

Cavium ThunderX2

1/8th Brick, V(IN) = 52V, V(OUT) = 12V

ECB: LM5066i

Input (52V)

Socket 0: CPU Vcore
VR13 SVID + PMBus
V(IN) = 52V

Socket 0: CPU VCCSA
VR13 SVID + PMBus
V(IN) = 12V

Socket 1: CPU Vcore
VR13 SVID + PMBus
V(IN) = 52V

Socket 1: CPU VCCSA
VR13 SVID + PMBus
V(IN) = 12V

Socket 1: CPU VCCIO
VR13 SVID + PMBus
V(IN) = 12V

Same Vcore solution is being used on the XC50 Cavium ThunderX2 blade
Cray PMDB Updates in SMW 8.0.UP06

- PMDB time series data changed to use TimescaleDB
  - TimescaleDB is a fully integrated PostgreSQL extension
  - Replaces previous Cray partition based implementation
  - Integration with SQL query planner results greater efficiency

- New PMDB configuration utility
  - New `pmdb_util` utility replaces previous utilities (`pmdb_auto_migrate`, `init_pmdb`, etc.)
  - Provides ability to configure and now check PMDB in single place
TimescaleDB in Cray PMDB

- Abstracts idea of a single continuous table
  - Top level “hypertable” is sharded into many partitions/chunks
  - Treated like standard PostgreSQL table

- Transparencly partitions based on time/space
  - Each chunk contains a known time interval

- Allows aggressive query optimization
  - Only chunks that can contain data are ever scanned
  - Speedup of at least 2x with most queries
Cray XC50 APM Usage Examples

Stream runs with supported p-states
Xhpl run with power capping
Stream Runs with Supported P-States

ALPS aprun --p-state=<kHz> at job launch over supported frequencies
Stream reported “Best Rate MB/s” normalized over all runs
Stream Run with P-States Sweep

Dynamic p-state limiting with CAPMC of running stream job
Xhpl with Power Capping (Ramp Up)
Xhpl with Power Capping (Ramp Up)

![Graph showing Power Watts over time with various power levels and times.](image-url)
Xhpl (Not Power Capped)
Cray APM Supported on All XC Compute Blades

- Advanced monitoring and control
  - Telemetry data published into PMDB and CLE:/sys/cray/pm_counters
  - CAPMC enables dynamic monitoring and control

- New XC50 blades using new 52VDC → VCORE solution
  - Smaller footprint, full PMAX power
  - More accurate monitoring, and reduced power distribution losses

- Cray PMDB Updates in SMW 8.0.UP06
  - PMDB now using TimescaleDB (fully integrated PostgreSQL extension)
  - Utility pmdb_util replaces previous utilities to manage & configure PMDB
Q&A

Steven J. Martin
stevem@cray.com
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