Total-power Usage Effectiveness (TUE) Sequoia Case Study

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Anna Maria Bailey, PE

Lawrence Livermore National Laboratory

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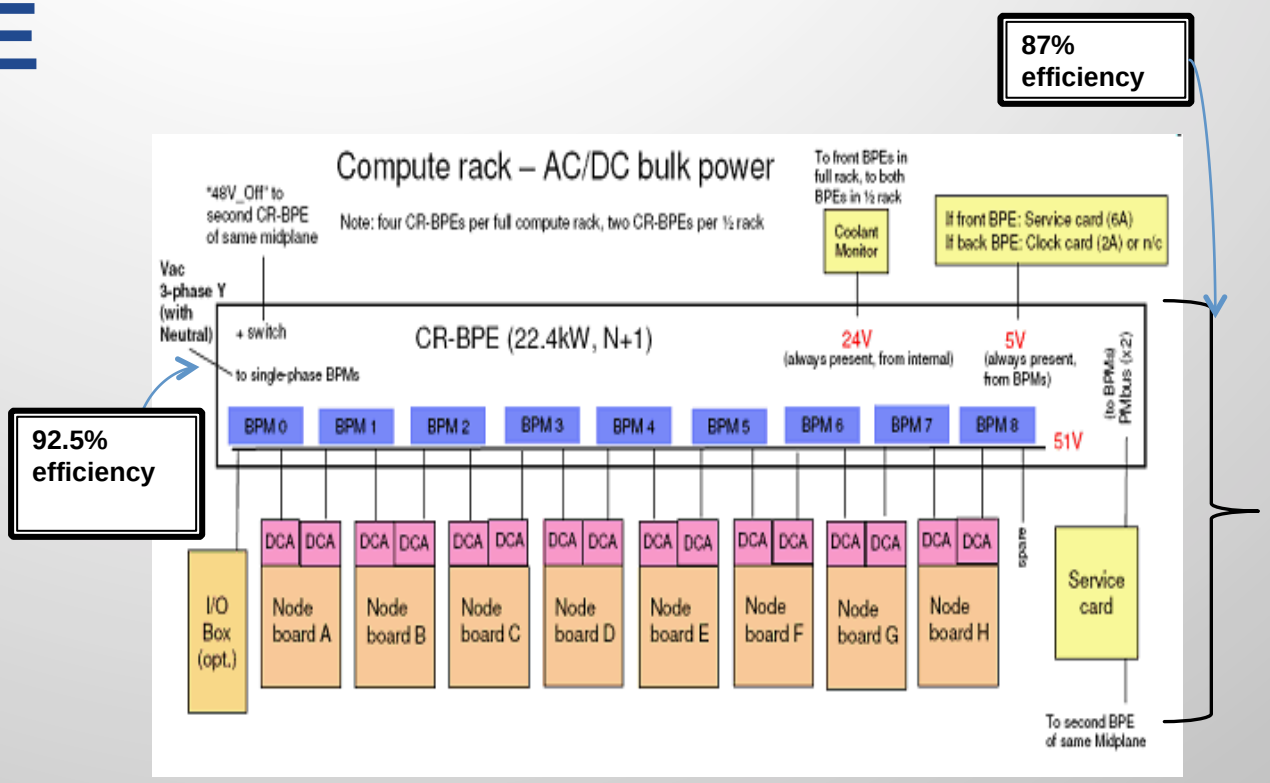
Sequoia Parameters

- IBM Blue Gene*/Q architecture
- 98,304 nodes
- 1,572,864 cores
- 20 PF, 3rd on Top 500 – June 2013
- 96 racks
- 91% liquid cooled
- 30 gpm/rack at 62 F
- 9% air cooled
- 1700 cfm/rack at 70 F
- 4800 square feet
- *Copyright 2013 by International Business Machine Corporation

Sequoia ITUE

- No power from the rack AC connection is used to cool the racks
- Power to cool the racks is in the measured PUE
- Power lost is due to conversion efficiency
- Two levels
  - AC to DC (92.5%)
  - Regulation Module & Transformer (~87%)



$$\text{ITUE} = \frac{\text{Total Sequoia measured power}}{\text{Total Sequoia compute power}} = \frac{6118}{(6118)(0.925)(0.87)} = 1.24$$

Sequoia TUE

- TUE (Sequoia) = ITUE(Sequoia) x PUE(Facility)
- ITUE (Sequoia) = 1.24
- PUE (Facility) = 1.27

Metric	Measured	Estimated
ITUE		Estimated based on vendor efficiency estimates
PUE	Fully metered per rack, system and facility	

TUE = 1.24 × 1.27 = 1.57

Opportunities/Challenges

- Allows the ability to forecast the performance of a given system in different facilities to evaluate overall efficiencies
- ITUE and TUE measuring capabilities will need to be specified in future HPC procurements
  - Need to include IPMI and other platform monitoring schemes to have some component level monitoring
- The enhancement of the metrics will take time to develop requiring more case studies to be performed to compare and contrast results and leverage the metric forward
- The evolvement of the ITUE and TUE metrics will require more EEHPCWG champions

Questions

Anna Maria Bailey
Lawrence Livermore National Laboratory
7000 East Ave PO Box 808 L-554
Livermore, CA 94550
Phone - (925) 423-1288
Email – bailey31@llnl.gov