

Beacon: A Path to Energy-Efficient HPC

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Approach

- Entire system designed to target energy-efficiency
- Custom HPL implementation – not MKL
 - Targets energy-efficiency
 - Optimized for 4 coprocessors per node
- Dynamic power management
- Minimized power consumed by unused components
 - For example, unused USB and Ethernet ports
- Summary: co-design of software and hardware to maximize energy efficiency

Hardware

- Entire system designed to target energy-efficiency

Beacon Green500 Cluster	
Nodes	36 compute
CPU model	Intel® Xeon® E5-2670
CPUs per node	2x 8-core, 2.6GHz
RAM per node	256 GB
Intel® Xeon Phi™ Coprocessor 5110Ps per node	4
Cores per Intel® Xeon Phi™ coprocessor 5110P	60 @ 1.053GHz
RAM per Intel® Xeon Phi™ coprocessor 5110P	8 GB GDDR5

Sanity Check – Original Estimates

- Power:
 - 2x Intel® Xeon® E5-2670 @ 115W TDP
 - 4x Intel® Xeon Phi™ Coprocessor 5110Ps @ 225W TDP
 - 256 GB RAM: 16 DIMMs @ 6 W ea. = 96 W
 - *Chassis: 120W (cooling + other)*
 - Approximate total power: 1346 W (theoretical)
- Peak performance:
 - 4x Intel® Xeon Phi™ coprocessor 5110P: 4040 GFLOPS
 - 2x Intel® Xeon® E5-2670: 330 GFLOPS
 - Approximate total performance: 4370 GFLOPS

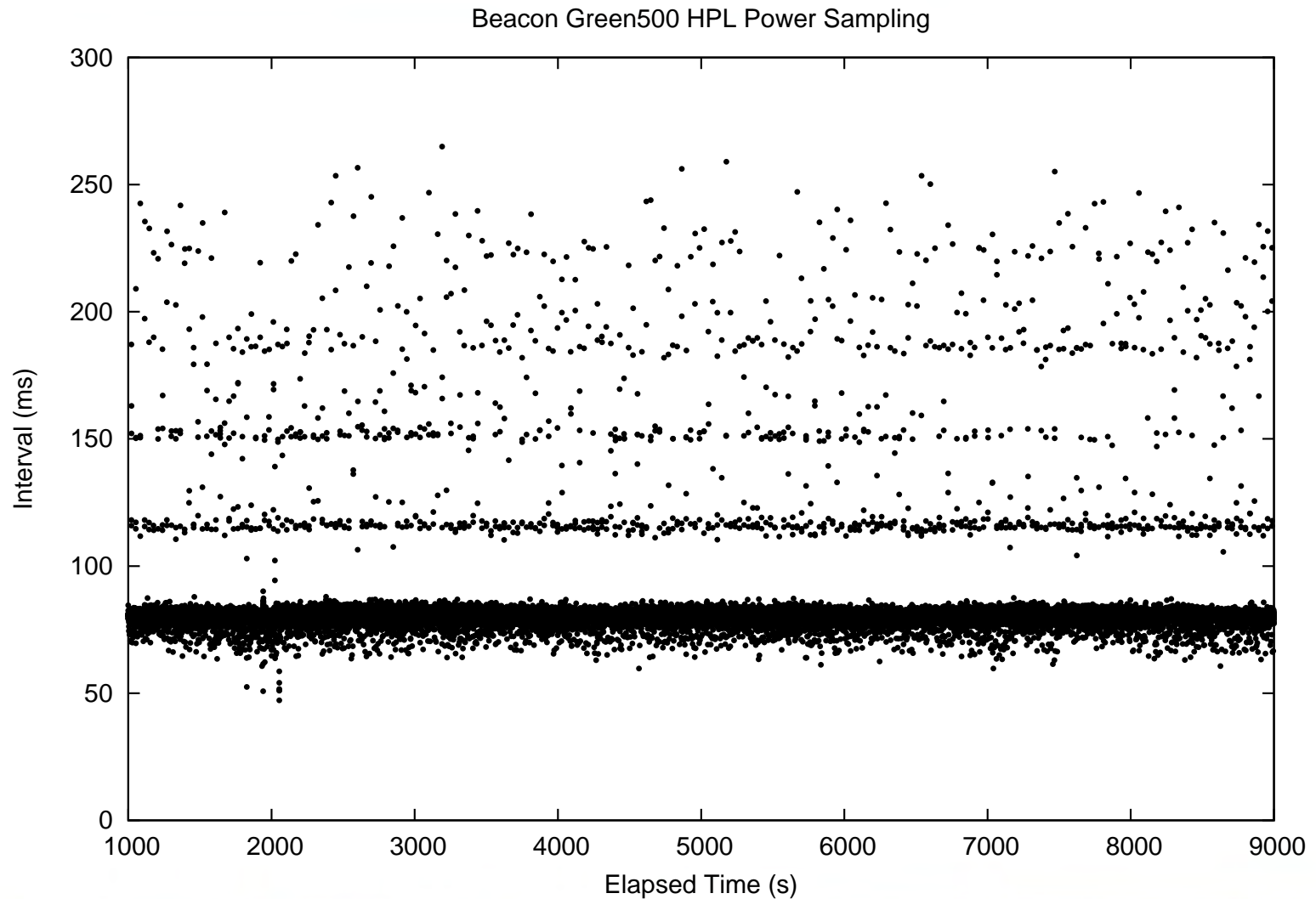
Sanity Check – Original Estimates

- Power: ~ 1346 W
- Performance: 4370 GFLOPS
- Assume 92% efficiency for power conversion:
 - $1342/0.92 = 1458.7$ W AC
- Assume 71.4% efficiency for HPL:
 - $4370 * 0.7 = 3120.18$ GFLOPS
- Approximate MFLOPS/W:
 - $3120.18 / 1458.7 = 2139$ MFLOPS/W before optimizations

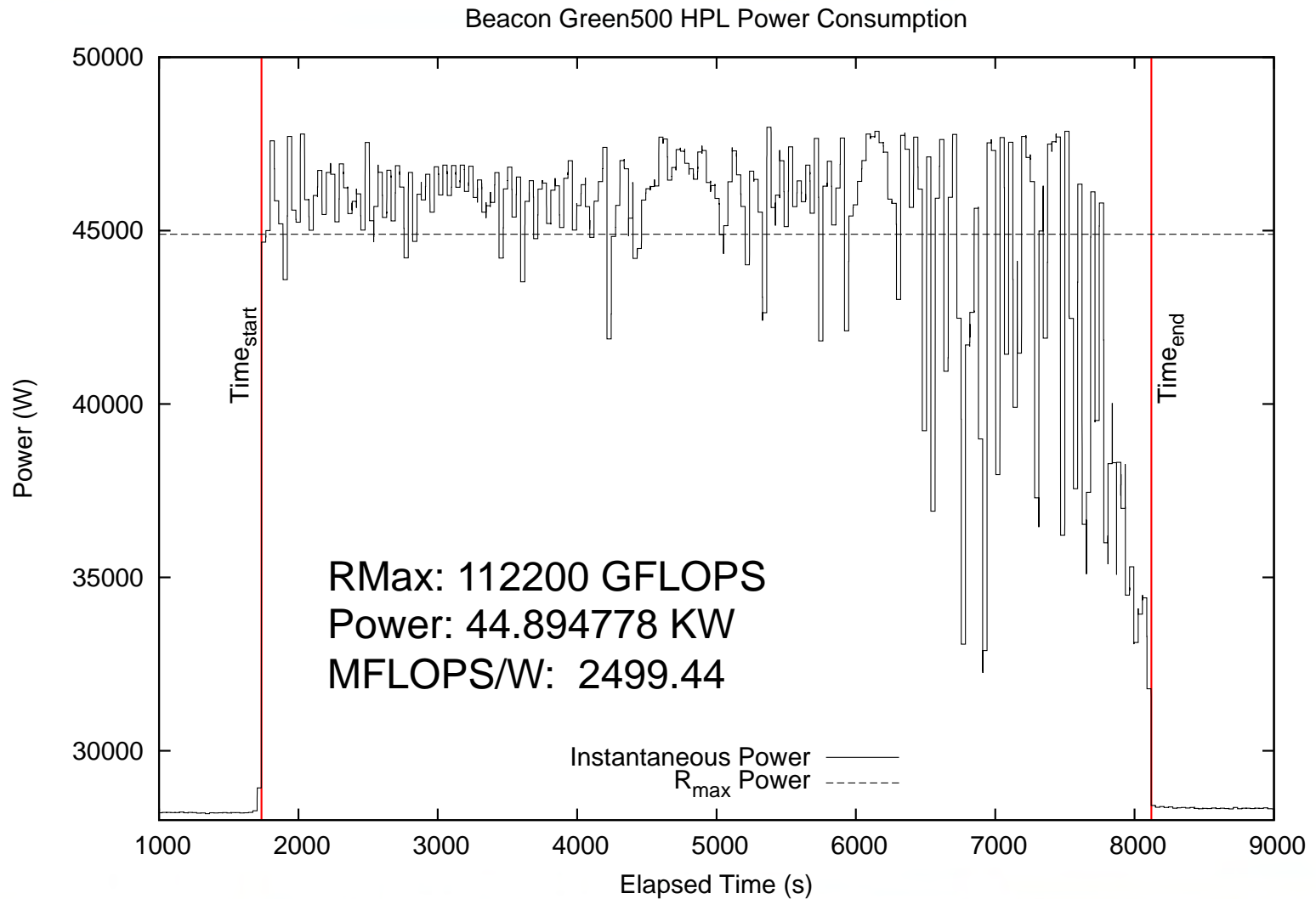
Methodology

- 4+1 power supplies per subrack
- Each power supply implements the PMBus spec.
 - CF 6
 - Instantaneous AC input (RMS)
- Used iSCB interfaces to continuously poll every power supply in all of the subracks in the system
- Measured power of the InfiniBand switch separately
 - Peak just below 90W
 - Added to Rmax Power measured from power supplies

Power Sampling



Power Consumption



Contact Information

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