

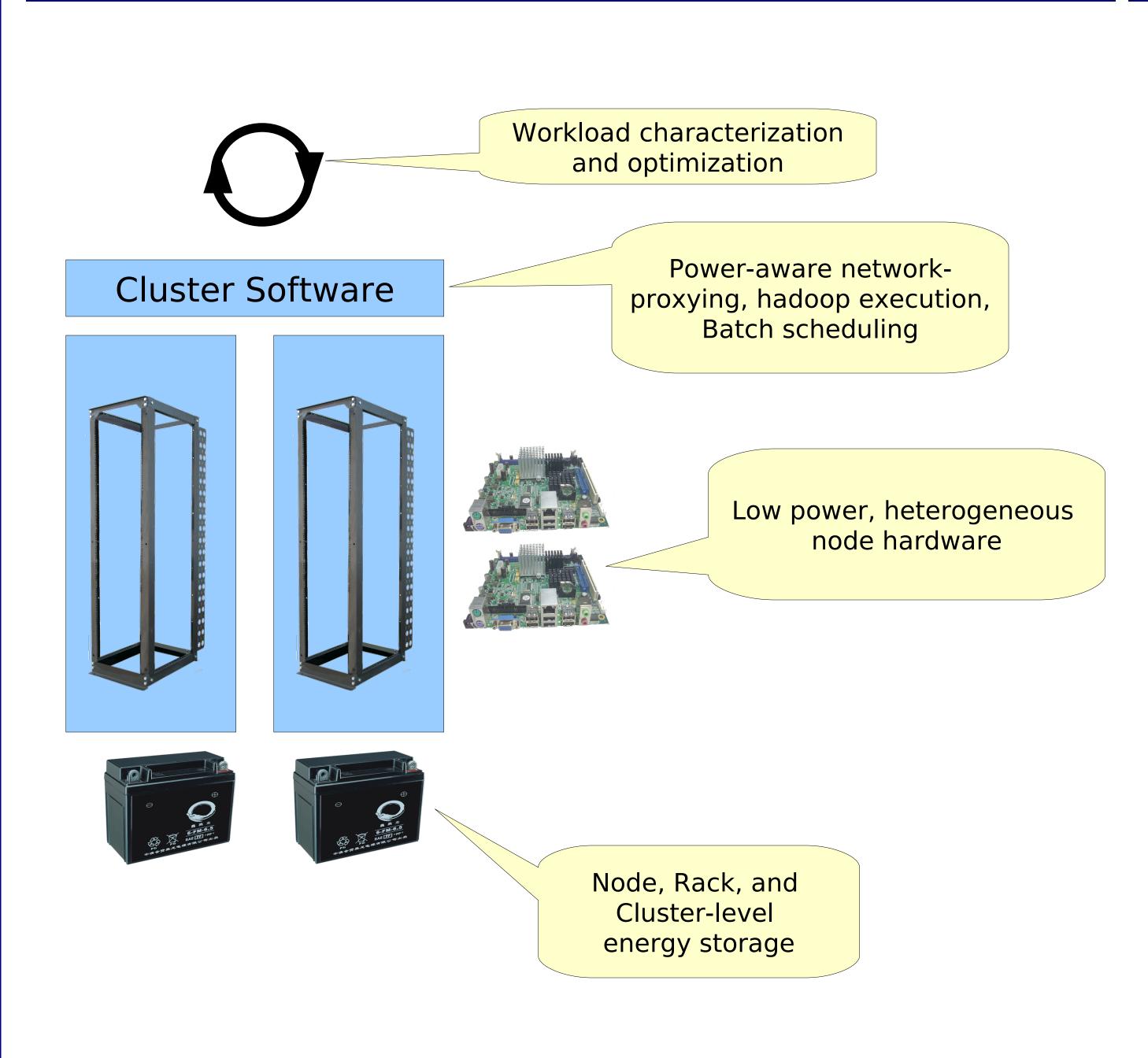
The LoCal Computing Cluster



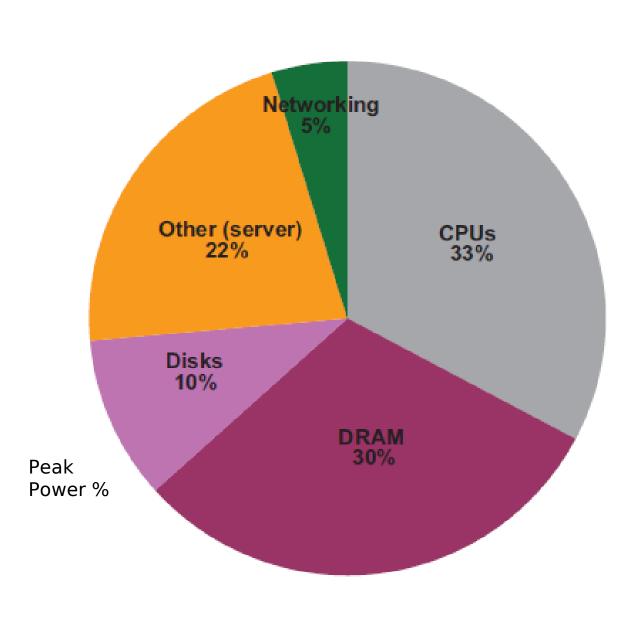
Sara Alspaugh, Yanpei Chen, Stephen Dawson-Haggerty, Laura Keys, Andrew Krioukov

Local Cluster Architecture

Sleep-Enabled Cluster Software



721.Millennium.Berkeley.EDÜ 8 4.0 k 2.0 k 0.0 16:00 16:20 16:40 80 10ad_one last hour (now 3,50	r30.Millennium.Berkeley.EDU 8 10 16:00 16:20 16:40 9 10 16:00 9.01	79.Millennium.Berkeley.EDU 0 2.0 16:00 16:20 16:40 95 10:00 16:00 16:20 16:40 95	r10.Millennium.Berkeley.EDŪ
r26.Millennium.Berkeley.EDU	r13.Millennium.Berkeley.EDU	r15.Millennium.Berkeley.EDÜ	r11.Millennium.Berkeley.EDU
R31.Millennium.Berkeley.EDÜ 8 200 m 100 m 16:00 16:20 16:40 m 10ad_one last hour (now 0.13	r28.Millennium.Berkeley.EDÜ	r58.Millennium.Berkeley.EDÜ 0 0.0 16:00 16:20 16:40 load_one last hour (now 0.04	r34.Millennium.Berkeley.EDU
727.Millennium.Berkeley.EDÜ 8 500 m 16:00 16:20 16:40 16:00 16:00 16:00 0.06	732.Millennium.Berkeley.EDÜ 8 400 m 0 200 m 16:00 16:20 16:40 8 10:00 lost hour (now 0.03	numper.Millennium.Berkeley.EU 20 m 16:00 16:20 16:40 Bload_one last hour (now 0.02	r40.Millennium.Berkeley.EDU 8 180 m 16:00 16:20 16:40 m 10ad_one last hour (now 0.02
r18.Millennium.Berkeley.EDÜ 8 400 m 0 200 m 16:60 16:20 16:40 m 10ad_one last hour (now 0.01	78.Millennium.Berkeley.EDU 8 200 m 100 m 0 16:00 16:20 16:40 100 m 16:00 16:20 16:40	r39.Millennium.Berkeley.EDÜ 8 60 m 15:00 16:20 16:40 10 load_one last hour (now 0.00	r38.Millennium.Berkeley.EDU 8 40 n 20 n 16:00 16:20 16:40 mload_one last hour (now 0.00
737.Millennium.Berkeley.EDÜ 8 200 m 0 100 m 0 16:00 16:20 16:40 10ad_one last hour (now 0.00	733.Millennium.Berkeley.EDÜ 0 16:00 16:20 16:40 10 10 10 10 10 10 10 10 10 10 10 10 10 1	r36.Millennium.Berkeley.EDÜ 8 500 m 16:00 16:20 16:40 m load_one last hour (now 0.00	735.Millennium.Berkeley.EDU 8 280 n 0 16:00 16:20 16:40 10 load_one last hour (now 0.00
24.Millennium.Berkeley.EDÜ 8 60 16:00 16:20 16:40 10:00 10:00 10:00	r17.Millennium.Berkeley.EDÜ 8 400 m 0 200 m 0 16:00 16:20 16:40 10 load_one last hour (now 0.00	16.Millennium.Berkeley.EDÜ 8 50 40 11 16:00 16:20 16:40 10:00 10:00 16:00 16:40	12.Millennium.Berkeley.EDU 8 100 m 16:00 16:20 16:40 m 16:00 lost hour (now 0.00
r7.Millennium.Berkeley.EDU	16:00 16:20 16:40	720.Millennium.Berkeley.EDÜ 8 500 m 16:00 16:20 16:40 10:00 16:20 16:40	25,Millennium.Berkeley.EDU 8 100 m 0 16:00 16:20 16:40 100ad_one last hour (now 0.00
76.Millennium.Berkeley.EDU	723.Millennium.Berkeley.EDÜ 8 6 8 8 16:20 16:40 8 8 8 8 9 16:20 16:40 8 8 9 16:20 16:40 8 9 16:4	722.Millennium.Berkeley.EDÜ 8 60 m 16:00 16:20 16:40 m 10:00	729.Millennium.Berkeley.EDÜ 8 100 n 0 16:00 16:20 16:40 m 10ad_one last hour (now 0.00

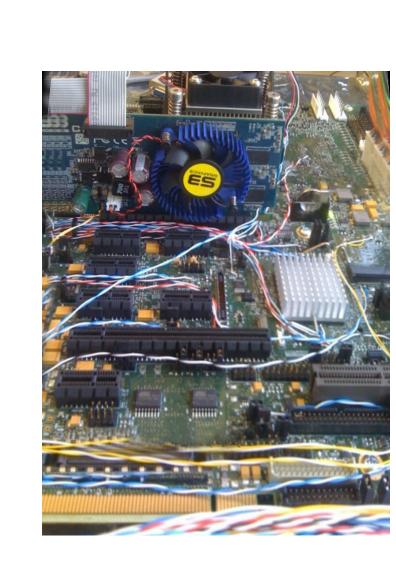


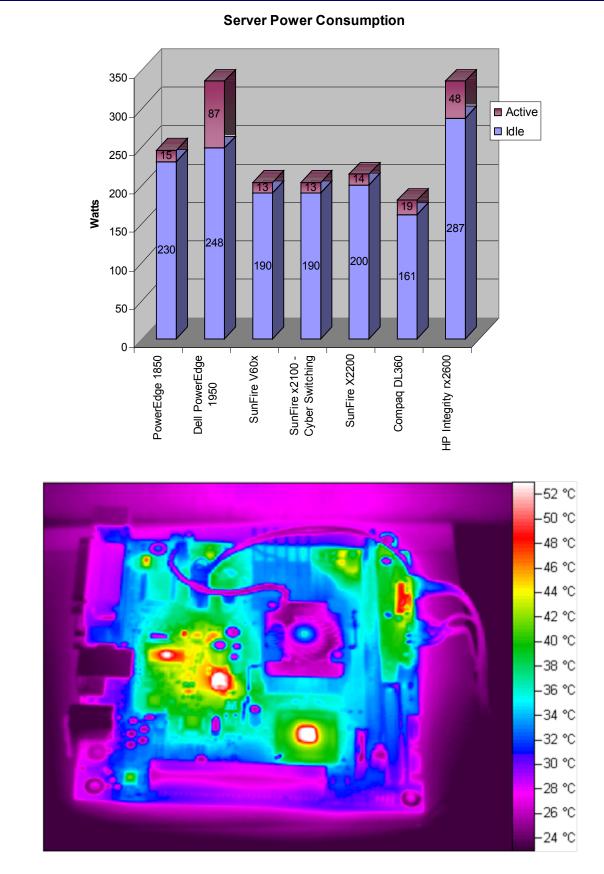
- Many clusters are very underutilized, but don't sleep
- Network protocols maintain maintain liveness with keepalives,
- Local projects
 - "Green" Ganglia: update ganglia to put machines to sleep when not in use
 - Network Proxying: explore the cost of maintaining an always on illusion with protocol proxies

Workload Characterization

Fraction Energy fraction Shuffle HDFSWrite HDFSWrite O.2 O.4 O.5 O.6 O.4 O.6 O.4 O.7 Duration fraction Shuffle HDFSWrite HDFSWrite HDFSWrite HDFSWrite HDFSWrite HDFSRead 1 4 8 12

Hardware





- How well do we need to understand a workload to execute it efficiently?
- Locate most efficient execution point based on parallelization overhead and available hardware
- Local projects:
 - Examine workload efficiency on different architectures of hadoop, SPECInt, etc.
 - Explore job assignment algorithms: power proportional Hadoop?
 - Build a distributed JouleSort competitor
 - Develop tools to measure and attribute power drain

- The hardware is what uses the power!
- Examine power distribution, architectural features
- Local projects:
 - Build a cluster computing resource platform:
 - Node, rack, and cage-level storage elements
 - Energy-efficient hardware with low idle powers and usable sleep (S3) states.