PowerNet: A Magnifying Glass for Computing System Energy

http://powernet.stanford.edu

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Problem:

Electricity powers our everyday computing, yet we have no visibility into how this power is consumed. Detailed power usage data can improve how we design, select, manage, and use our computing devices and infrastructure.

Solution:

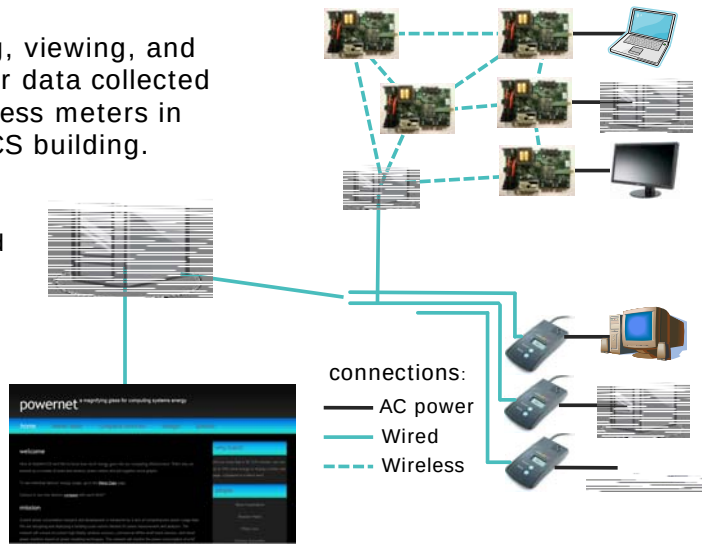
The goal of PowerNet is to provide data, together with utilization statistics, to answer questions about total power usage, variation, and efficiency. We will release all the collected data and created tools back to the research community.

PowerNet

is a platform for collecting, viewing, and analyzing plug-level power data collected from both wired and wireless meters in Gates Hall, the Stanford CS building.

Database
Stores all meter data and utilization statistics.

Web Interface
View and analyze real-time and collected power data for each meter.



Wireless (5 -100)
Stanford-designed meters form a mesh network to provide over 10,000 samples/second, per meter.

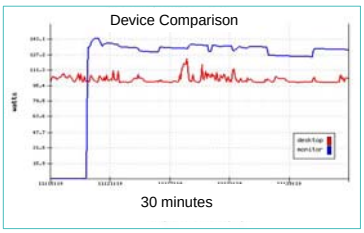
Meters are calibrated to better than 1% accuracy.

The sensors use 802.15.4 low-power wireless and open-source OS – TinyOS.

Wired (100)
Commercial off-the-shelf Ethernet-based power meters provide up to 1 sample per second, per meter.

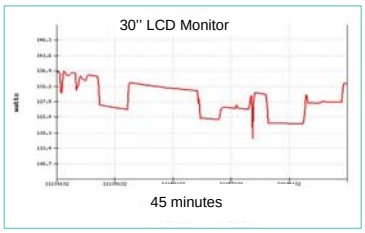
Initial Insights

Desktops vs Monitors: Which uses more power?



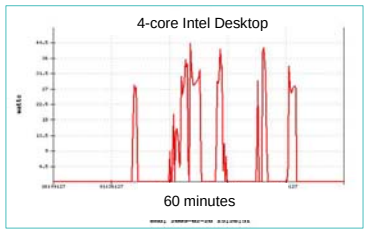
A 30'' LCD screen uses more power than a quad processor Dell desktop with 100% CPU utilization on one core.

Does desktop color affect monitor power draw?



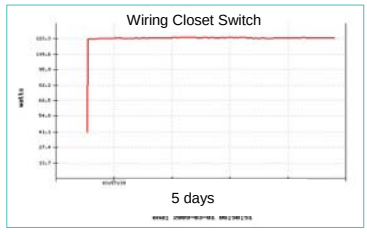
Data says… yes. A webpage with white background uses over 10% more energy than a black terminal window.

How often are computers idle vs active?



Active utilization over one week ranged from 0% to ~40%, with power draw from 25W to 118W. One laptop is shown above.

Are networks energy proportional?



Data says… no. The wiring closet switch measured above showed < 1% power variation over 5 days.

Next Steps

- Improve the custom wireless node design
  - Include expansion port to encourage external innovation
- Expand the wireless deployment
- Release power data traces to the research community
- Correlate more data with utilization stats, ex.:
  - CPU and memory utilization
  - Network bandwidth utilization
  - Workload configuration and scenarios

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