Software Energy Profiling Tools: What's out there?

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A few words…

- New energy profiling tools are constantly developed
- This is the result of an explorative search
- We focused on ready-to-use solutions

Sort things out...

- **General-purpose:** profile software energy efficiency on various platforms
- **Mobile:** specifically developed for mobile platforms
- **Resource monitoring:** gather resource usage information from the platform, useful for prediction/correlation

Sort things out...

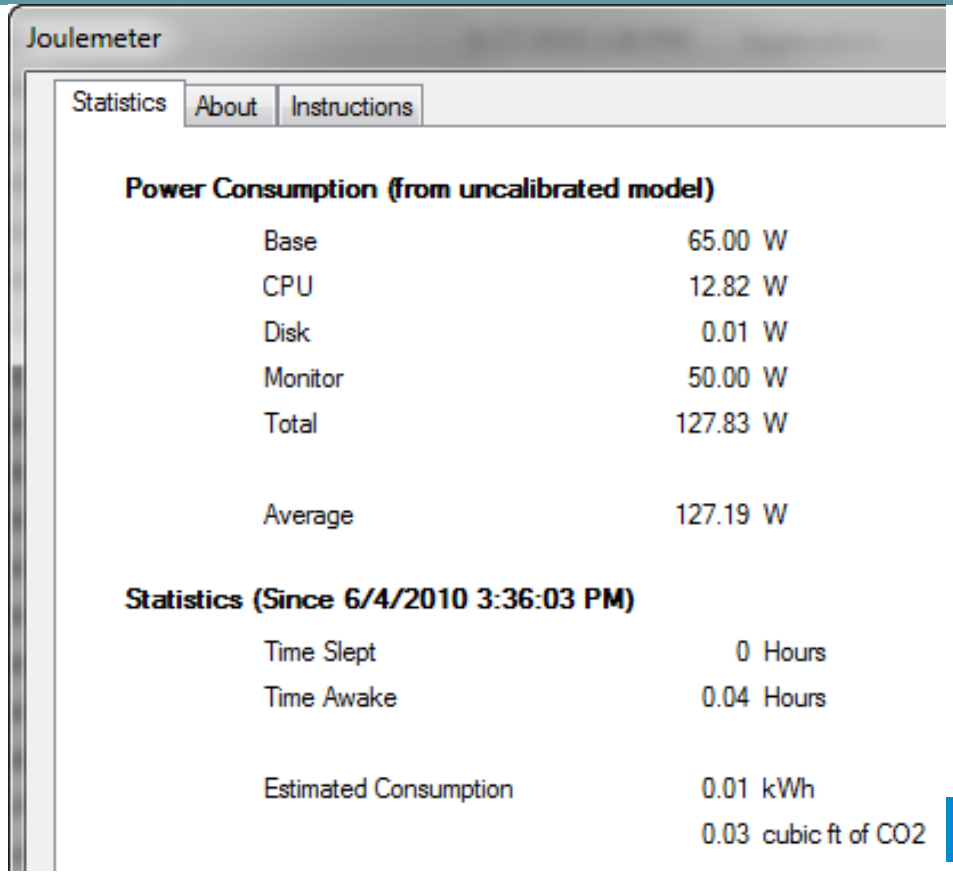
General-purpose	Joulemeter PowerTOP Intel Energy Checker
Mobile	ARO PowerTutor
Resource Monitor	PerfMon DStat

General-purpose tools

Joulemeter

- http://research.microsoft.com/en-us/projects/joulemeter/
- Platform: Windows (desktop/laptops)
- Pros:
  - Ease of use
  - Per-application estimation
  - Good accuracy
- Cons:
  - Needs initial calibration
  - Only supports a specific model of power meter (Wattsup PRO)
  - Windows-only

General-purpose tools: Joulemeter

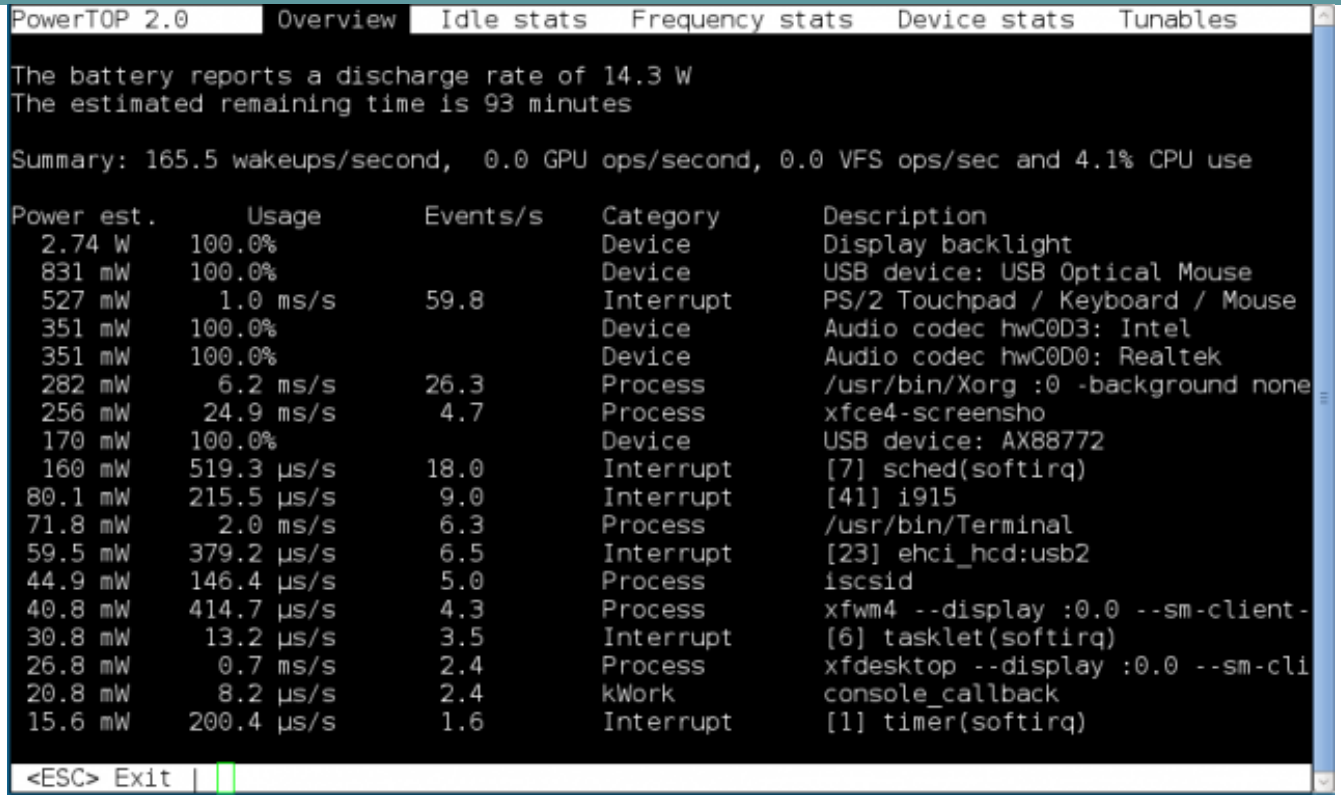


General-purpose tools

PowerTOP

- https://01.org/powertop/
- Platform: Linux (desktop/laptops)
- Pros:
  - Per-application estimation
  - Power management support
  - Provides information about devices and peripherals
- Cons:
  - Needs initial calibration
  - Effective estimation only available on battery-powered devices
  - Linux-only

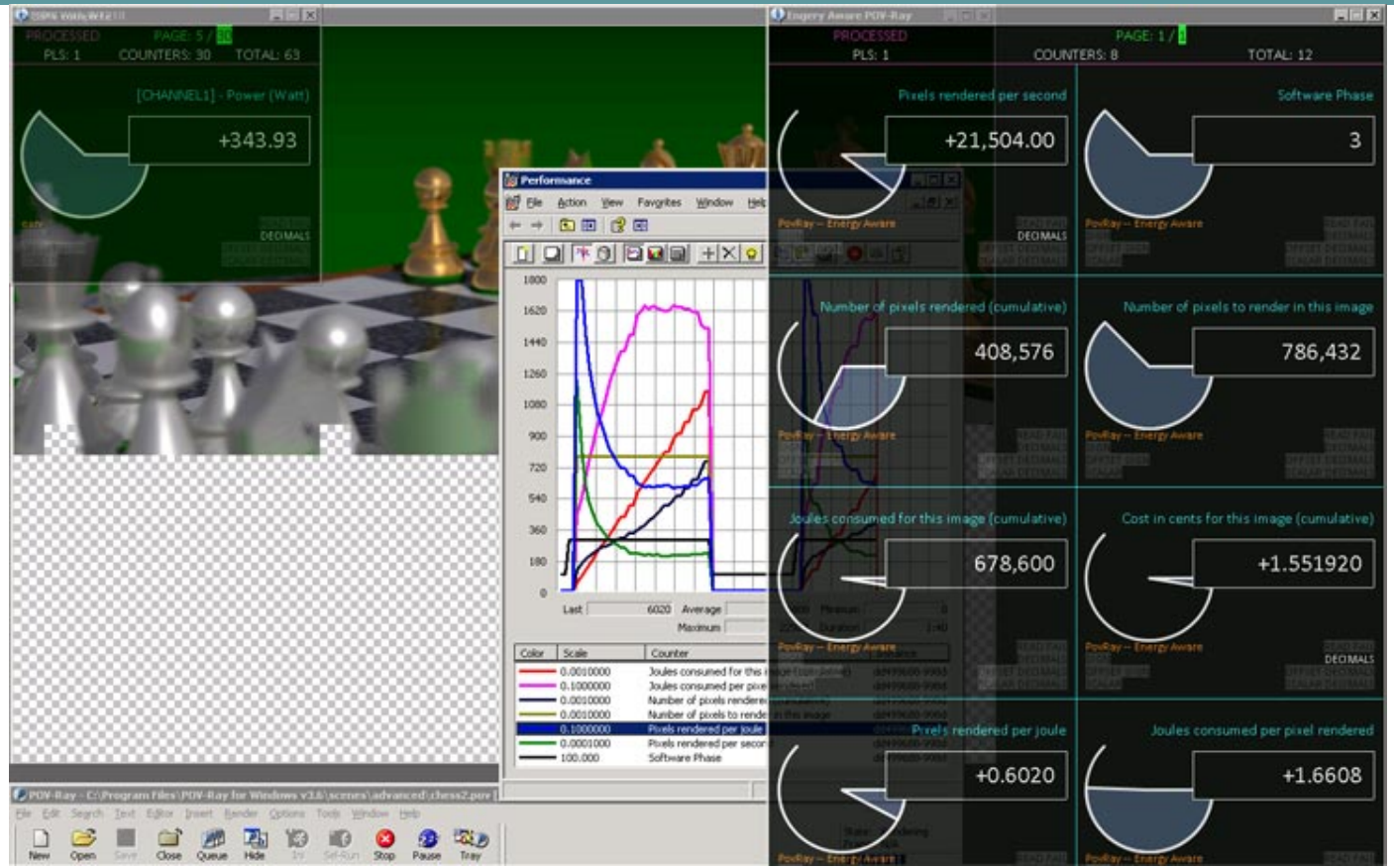
General-purpose tools: PowerTOP



Intel Energy Checker

- http://software.intel.com/en-us/articles/intel-energy-checker-sdk
- Platform: Windows/Linux/Solaris/Mac OS X (desktop/laptops)
- Pros:
  - Multi-platform compatibility
  - Fully customizable productivity metrics
  - Supports different models of power meters
- Cons:
  - Configuration of devices and components can be time-consuming
  - Low-level APIs (Wrapping of C libraries might be required)
  - Only relies on external power meters (no estimation)

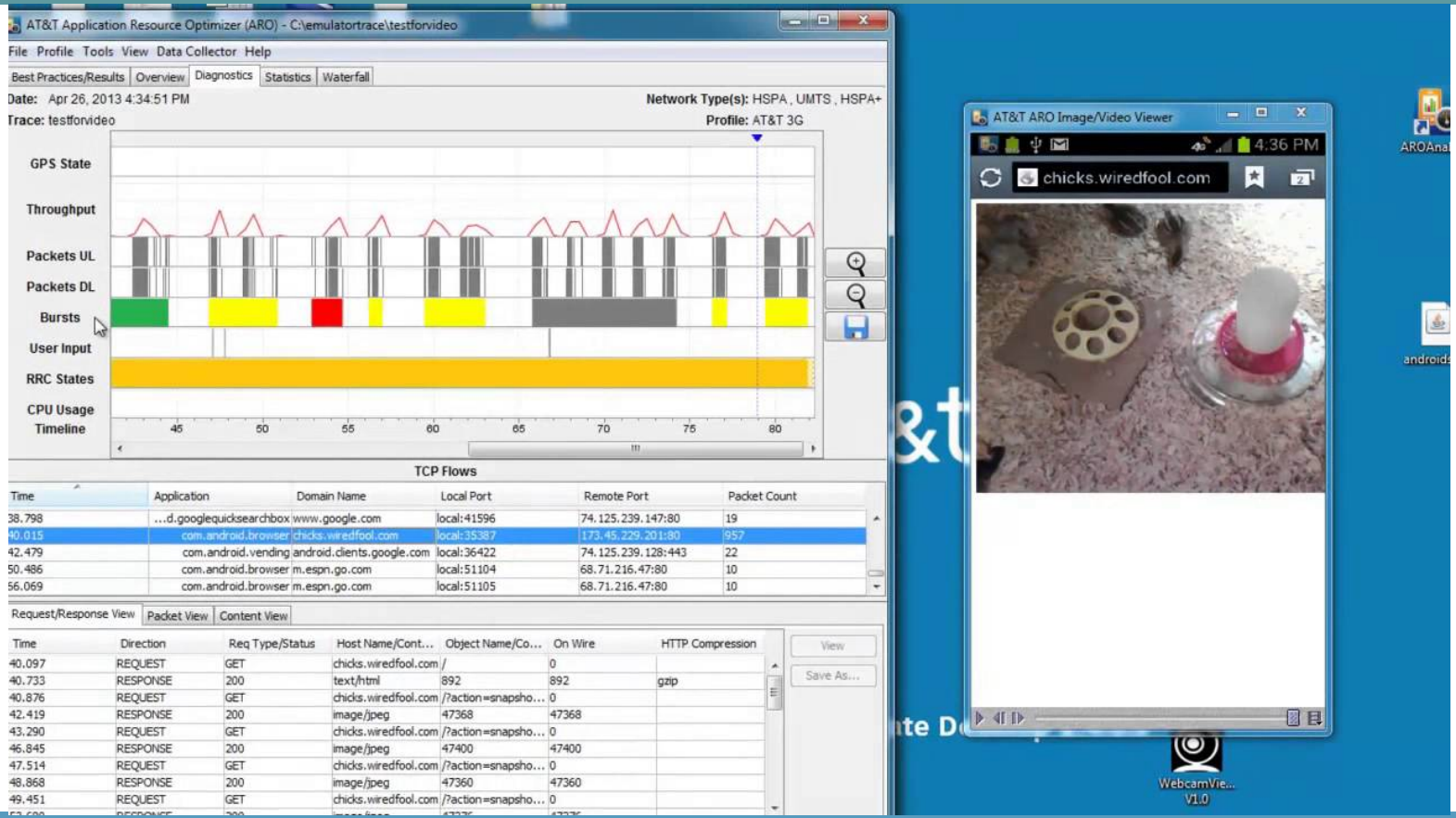
General-purpose tools: Intel Energy Checker



ARO (Application Resource Optimizer)

- http://developer.att.com/developer/basicTemplate.jsp?passedItemId=9700312
- Platform: Android/Windows 8
- Pros:
  - easy to use
  - provides focused hints to improve the energy efficiency of the analyzed application
- Cons:
  - works only on rooted android devices and windows 8 devices
  - does not provide real-time monitoring

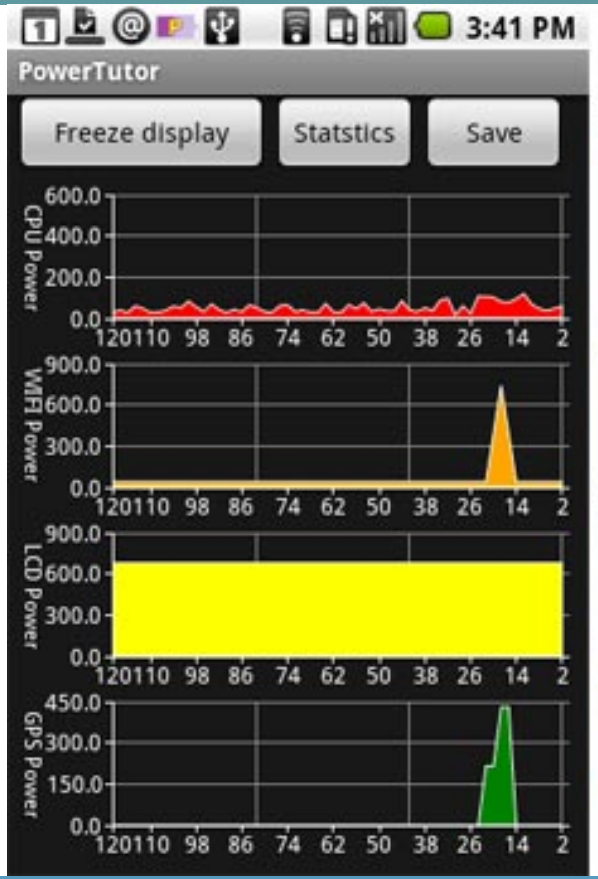
Mobile Applications: ARO

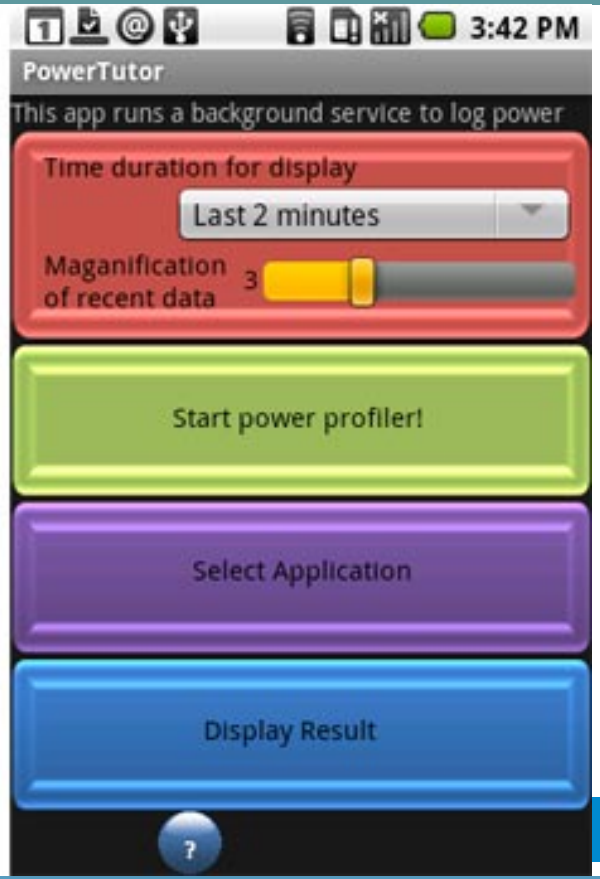


PowerTutor

- http://ziyang.eecs.umich.edu/projects/powertutor/
- Platform: Android
- Pros:
  - Available in the Google Play Store
  - No root privileges required
  - Graphs and charts are available or log files can be downloaded
- Cons:
  - Valid values for a subset of Android phones only
  - No APIs available

Mobile Applications: PowerTutor



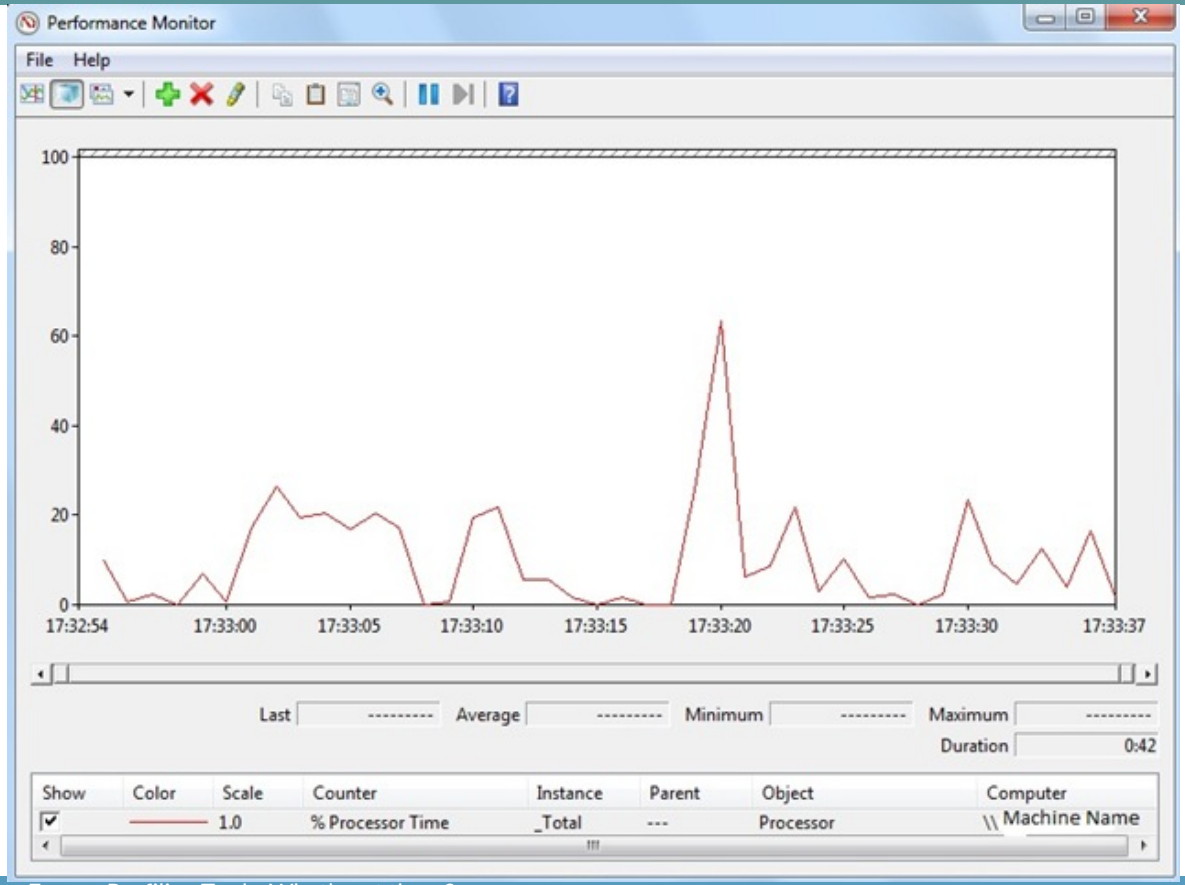


Resource monitoring

PerfMon

- Available on all Windows versions
- Platform: Windows
- Pros:
  - User-defined counter capability
  - CSV Logging
- Cons:
  - Low granularity (1 sec)
  - Accuracy varies according to specific resource (e.g. CPU is less precise than Disk Usage)

Resource monitoring: PerfMon



Resource monitoring

Dstat

- http://dag.wieers.com/home-made/dstat/
- Platform: Linux
- Pros:
  - Combines vmstat, iostat, ifstat, netstat information and more
  - CSV output
  - User-defined counter capability
- Cons:
  - Low granularity (1 sec)
  - Less counters available compared to PerfMon

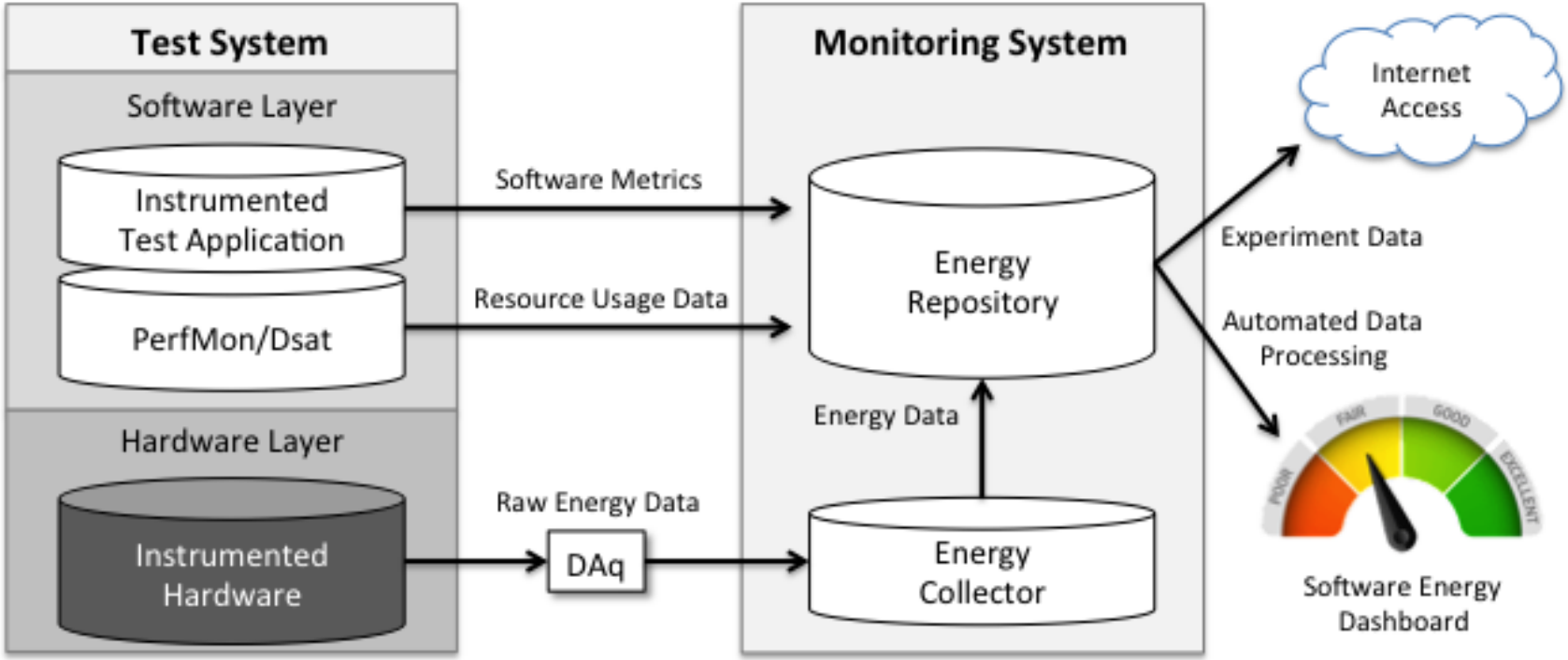
Resource monitoring: Dstat

```
#./dstat -cndymlp -N total -D total 5 25
----------cpu-usage---------- --network-- --disk-i/o- ---system-- ------memory-usage----- ---load-avg--- -procs--
usr sys idl wai hiq siq|___total___|___total___|_int_ _csw_|_used _free _buff _cach|_1m_ _5m_ 15m_|ru bl nw
  3   9   8   6  46  29|   0     0 |   0     0 |   0     0 |14.4G 14.9G    0  1424M| 356  277  271|204 231   0
 12  21   0   6  36  26|2397M 2405M|1579M 28.9M| 845k  211k|14.4G 15.0G    0  1267M| 357  279  272|216 238   7
 12  21   0   5  36  26|2450M 2465M|1600M 27.5M| 862k  208k|14.4G 15.1G    0  1147M| 358  280  272|180 215   7
 12  21   0   6  36  26|2476M 2493M|1597M 27.5M| 871k  216k|14.4G 15.3G    0   967M| 359  281  273|217 233   0
 12  19   0   5  37  27|2226M 2242M|1532M 31.2M| 808k  187k|14.4G 15.6G    0   673M| 359  283  273|187 237  19
 12  20   0   5  37  26|2415M 2437M|1586M 28.5M| 878k  193k|14.4G 15.6G    0   703M| 359  284  274|216 224   8
 12  20   0   6  36  27|2481M 2496M|1619M 24.6M| 895k  192k|14.4G 15.6G    0   723M| 360  285  274|223 224   0
 12  20   0   6  36  27|2382M 2397M|1579M 29.0M| 861k  195k|14.4G 15.6G    0   744M| 360  287  275|220 230   7
 12  21   0   5  36  27|2306M 2322M|1583M 28.5M| 836k  182k|14.4G 15.5G    0   826M| 360  288  275|197 240  14
 12  20   0   5  37  26|2479M 2497M|1612M 24.9M| 890k  189k|14.4G 15.5G    0   853M| 360  289  276|226 227   0
 11  21   0   5  36  26|2360M 2377M|1578M 27.2M| 847k  185k|14.4G 15.4G    0   906M| 360  291  276|201 233   7
 12  20   0   6  36  26|2423M 2441M|1596M 27.9M| 866k  191k|14.4G 15.4G    0   940M| 360  293  277|224 235   7
 17  18   0   8  33  24|2427M 2431M|1581M 28.2M| 857k  194k|14.4G 15.3G    0   987M| 360  293  277|68 279  50
 11  21   0   5  37  26|2496M 2523M|1616M 26.3M| 896k  207k|14.4G 15.3G    0  1014M| 361  295  278|210 223   9
 12  21   0   5  36  26|2338M 2348M|1568M 28.4M| 828k  191k|14.4G 15.2G    0  1067M| 362  296  278|224 232   7
 22  18   0   9  29  22|2370M 2388M|1597M 27.8M| 842k  192k|14.4G 15.2G    0  1110M| 362  298  279|213 223   7
 12  21   0   5  36  26|2481M 2498M|1614M 23.8M| 880k  198k|14.4G 15.2G    0  1129M| 363  299  279|218 220   0
 12  21   0   6  35  26|2261M 2272M|1580M 29.5M| 794k  177k|14.4G 15.1G    0  1216M| 362  300  280|200 237  14
 12  21   0   6  35  26|2449M 2463M|1606M 24.3M| 864k  185k|14.4G 15.1G    0  1219M| 362  300  280|178 227   0
```

A final note

- **Performance Profiling Tools excluded on purpose**
  - Language-dependent
  - Performance and energy are not always highly correlated
  - http://en.wikipedia.org/wiki/List_of_performance_analysis_tools

Our Vision


Test System
Software Layer
Instrumented Test Application
PerfMon/Dsat
Hardware Layer
Instrumented Hardware
Software Metrics
Resource Usage Data
Raw Energy Data
DAq
Monitoring System
Energy Repository
Energy Data
Energy Collector
Internet Access
Experiment Data
Automated Data Processing
POOR
FAIR
GOOD
EXCELLENT
Software Energy Dashboard

Thank you!

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