Effects of Software on Computer Power Usage

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Abstract

As more and more computing work is pushed out to mobile devices, power consumption becomes increasingly important to deliver the balance of performance and battery life end users need. We intend to study the effects that different software programs, including operating systems and applications have on computer power consumption. Further, equipped with this knowledge we aim to optimize the system for power consumption depending on the current workload.

Introduction

Typical computer power management strategies rely on reducing power usage by removing power from unused devices and dynamically scaling operating voltage and clock frequency. That is to say, these approaches are primarily hardware-centric. While these approaches are able to offer significant performance improvement in many usage cases, they only take into consideration total system load. This would be an adequate approach for single-purpose computers, however general-purpose computers running modern multitasking operating systems run many concurrent processes, each contributing their own share of work and power consumption.

By studying different applications, including operating system components, we can identify tasks which are significant contributors of power consumption. In some cases, it may be possible to disable or reduce the execution frequency of less important tasks that consume a significant amount of power. Furthermore, by comparing the power performance of multiple applications designed to perform the same task, we can make recommendations as to what software packages are the most power-friendly.

Prior Work

At a broader level, Windows and Linux operating systems have been compared for their power consumption at different frequency levels and at different loads. The reasons for the difference has not been explored clearly and hence optimization for work load based power consumption could be developed further. Comparisons are often done for servers as power consumption often influences choice of operating system. However, studies for home users have not been to the same extent. Linux has seen development of PowerTOP which finds unnecessary programs consuming power in idle mode. Tickless Idle is another project that eliminates the periodic timer tick to save power.

Technical Details

We intend to use a standard x86-based notebook computer as our test platform. We will implement our power monitoring by making use of the internal power management systems integrated into modern notebook computers, as well as conventional electronics test equipment. By making use of conventional test equipment as well as the computer's internal power management data, we can verify that the computer is providing accurate power consumption data as well as monitor the power consumption of individual components if necessary.

Much of our testing of operating system components will use the Linux operating system, as its' open-source and modular design enables us to operate the system disabling key components that would be difficult or impossible to disable on a Windows platform. We will test application software on both Windows and Linux platforms, allowing us to compare results for the same application running on Windows or Linux if versions exist for both operating systems, (Mozilla Firefox, Matlab, or LibreOffice for instance) as well as comparing the results of different applications which serve the same purpose. In order to deliver accurate results, we will test typical usage cases for each application. For instance, applications such as web browsers are not typically processing large quantities of data, where a scientific application such as Matlab does exactly that.

We would also be using benchmarking

software, though not yet decided, to find the trends in operating systems and in applications. Once the trends are established, there is a scope to develop a 'Browser-oriented' mode which would disable or kill unnecessary processes which run in the background and have less than 10% utilization. We believe that this will deliver significant power savings to many users due to the extreme proliferation of web-based applications in modern consumer computing.

Project Schedule

- September 30: Testing and analysis of processes' & applications' power consumption in Windows and Linux.
- November 4: Development of trends for specific software applications.
- December 16: Development of optimization techniques and 'Browser-oriented' mode.

References

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