Title

The Security and Privacy Implications of Energy-Proportional Computing

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Date of Award

9-2013

Document Type

Open Access Dissertation

Degree Name

Doctor of Philosophy (PhD)

Degree Program

Computer Science

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Subject Categories

Computer Sciences

Abstract

The parallel trends of greater energy-efficiency and more aggressive power management are yielding computers that inch closer to energy-proportional computing with every generation. Energy-proportional computing, in which power consumption scales closely with workload, has unintended side effects for security and privacy. Saving energy is an unqualified boon for computer operators, but it is becoming easier to identify computing activities by observing power consumption because an energy-proportional computer reveals more about its workload.

This thesis demonstrates the potential for system-level power analysis---the inference of a computers internal states based on power observation at the "plug." It also examines which hardware components and software workloads have the greatest impact on information leakage. This thesis identifies the potential for privacy violations by demonstrating that a malicious party could identify which webpage from a given corpus a user is viewing with greater than 99% accuracy. It also identifies constructive applications for power analysis, evaluating its use as an anomaly detection mechanism for embedded devices with greater than 94% accuracy for each device tested. Finally, this thesis includes modeling work that correlates AC and DC power consumption to pinpoint which components contribute most to information leakage and analyzes software workloads to identify which classes of work lead to the most information leakage.

Understanding the security and privacy risks and opportunities that come with energy-proportional computing will allow future systems to either apply system-level power analysis fruitfully or thwart its malicious application.

Recommended Citation

Clark, Shane S., "The Security and Privacy Implications of Energy-Proportional Computing" (2013). *Open Access Dissertations*. 782.
https://scholarworks.umass.edu/open_access_dissertations/782

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