Power Management on Mobile Devices with Virtual Machines

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1. INTRODUCTION

Virtualization is a technology well known on servers and desktop computers, where it is mainly used to increase machine utilization and power is virtually unlimited. On mobile devices virtualization allows for high-assurance isolation between secure and insecure components [3, 4]. For their power supply mobile handsets rely on batteries with limited capacity and maximizing battery life is crucial. Thus complex power management facilities as well as in hard- and in software are implemented.

The aim of our work is to minimize the power consumption overhead induced by mobile virtualization.

The main contributions of our work are:

- To determine the overhead in terms of power usage that is related to CPU and memory virtualization on mobile devices without hardware virtualization.
- A power measurement system for mobile devices that is independent from the actual battery capacity.
- A model taking into account both the hardware characteristics and the constraints of diverse usage scenarios.
- We design and build a power management infrastructure that can enforce power management on mobile devices while sustaining multiple guest OSes.

In the rest of this work we present the main challenges. After we have outlined our measurement setup we will briefly describe our target system.

2. CHALLENGES

We identified four major challenges:

Limited measurement: Mobile devices are highly integrated which makes it virtually impossible to measure power usage of individual components. To deduce the impact of individual components a model of the device is required.

Power supply: For an accurate measurement a stable and constant power supply is needed. Intercepting voltage and current from the battery may lead to false results as those depend on its current capacity, which is dependent on several factors, e.g. the battery type and the temperature.

Distributed system: In a monolithic system the kernel has an holistic view on the power state. A system using virtualization behaves like a distributed system. An infrastructure is needed to both collect power management information and to instruct clients to adapt their power state.

Power management policies In a distributed system diverse dependencies between components exist. Components may have contradicting power requirements which may also conflict with a global policy.

3. MEASUREMENT SETUP

Because of the highly integrated nature of today's smartphones, the only choice for measuring power consumption is at the battery terminals. Smartphones communicate with the battery over a serial bus, such as I2C, to receive battery temperature, as well as to check the authenticity of the battery. In our measurement setup, after reconnecting the serial I/O, the phone is powered from an external power supply over a voltage regulator. This makes the setup independent from the battery capacity characteristics. The power consumption is measured with a precision Gossen Metrawatt Energy [1] multimeter that is capable of measuring power consumption directly, by measuring voltage and current simultaneously.

4. TARGET SYSTEM

Our research vehicle is an implementation of L4Android [5] on the Samsung Galaxy S2 smartphone. The system is based on a modern third-generation microkernel. L4Android is based on L4Linux [2], a version of Linux that has been ported to run as an application on the microkernel, and does not require hardware CPU virtualization capabilities.

5. REFERENCES

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