An Inexpensive Testbed For Mobile Device Power Measurement

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***Abstract*—In this paper, we outline our mobile device power measurement testbed, which is based on commonly available and inexpensive hardware components. Our setup offers whole mobile system power consumption measurements in a variety of scenarios and can readily modified to suit a broad range of implementation configurations. We demonstrate the suitability of our system with an Android application demo, which provides power measurement examples.**

Keywords—Energy consumption; testbed; measurement; Android

I. INTRODUCTION

The broad proliferation of mobile devices and associated services over the past decades has given rise to enormous challenges for green computing. Due to the increasing demand of data-driven services and their predicted continued increase [1], the battery consumption of mobile devices represents a limiting bottleneck. With multiple applications on mobile devices operating independently from one another, several power optimization suggestions have emerged [2], which are based on the common power distributions of mobile device components, see, e.g. [3]. While software-based energy profilers exist [4], it is not always feasible to implement them in a straightforward manner or desirable due to rapid development cycles. The alternative approach we present here is to perform measurements of power consumption on real world testbed implementations. Some of these specialized testbeds can be expensive, especially if it is desirable to measure the power consumption of individual components of a mobile device. Commonly, however, the development of new mechanisms is interested in a high level view that demonstrates the feasibility of the advantage of one mechanism over others. In these cases, a power consumption measurement of an entire device yields enough granularity and is presented in this demonstrator.

The remainder of this paper is structured as follows. In the next section, we present the overall setup and configuration of our measurement prototype. In Section III, we describe the demonstration of the prototype with a comparison of mobile application power consumption.

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II. SETUP AND CONFIGURATION

We illustrate the overall configuration of our system in Fig. 1. As illustrated, the system is comprised of several hardware components in addition to software, which is executed on the control device.

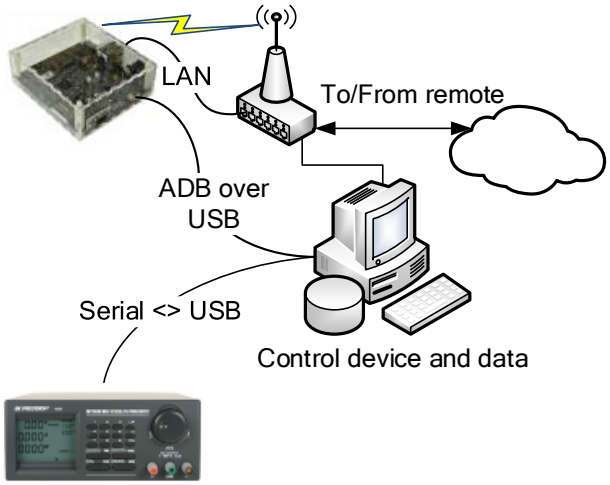

Fig. 1. Overall measurement testbed for mobile devices power consumption consisting of a mobile device (development board), switchable power supply with serial port, wireless access point, and control device (PC).

A. Hardware Configuration

The main component in our setup is the mobile device. This can be realized by using a smartphone and replace the battery with connectors to the power supply; alternatively one of the common development board packages, such as Pandaboard (see www.pandaboard.org) or Wandboard (see www.wandboard.org) packages. We utilized one of these development boards and smartphones together with the Android operating system, which provides log output via USB to the measurement control device, which can be a regular PC or another development board with Android debugging support. The mobile device is networked with a wireless access point, which allows for wired and wireless evaluations.

The switchable power supply has an external serial or USB port to communicate the current and power in small time intervals to the control device. We utilize the BK Precision

1696 switchable power supply, as it offers fine granularity in power, current, and time intervals. While other equipment, such as Arduino with custom circuits, were used in other measurement approaches, these power supplies are common lab equipment and offer overall robust features.

B. Software

The software components are comprised of several scripts that execute the Android Debugging Bridge (ADB) and capture the output either to a local file or allow sending the output to a remote receiver, as illustrated in Fig. 1. The scripts allow for easy customization on the locally connected control device or at a remote location, e.g., filtering by specific events in the log. Similarly, a locally executing script captures the output from the power supply and is enabled to forward the data to a remote location as well.

III. DEMONSTRATION

We will demonstrate the two different aspects of the measurement setup utilizing an example Android application that performs web requests. We will use a wired and wireless scenario to access a remote web service and retrieve results to exhibit the functionality of our setup.

Based on this basic scenario, we demonstrate the near real-time visualization of the data in a graph on a remote computer and show how the captured log files can readily be parsed for automatic evaluation of application power consumption using a combination of recorded video and screencasts.

We conclude by providing a related website with the tools available for download to facilitate direct implementations.

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