Reproducible Load Tests for Android Systems with Trace-based Benchmarks

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Motivation

How to prove energy savings?

- Measure max. performance of subsystems
- Do not cover Android-specific parts
- Do not represent a user’s behavior

Icons taken from Google (Play Store) + Wikimedia
Motivation

How to prove energy savings?

- Benchmark Generator
- Records an app’s resource usage during normal use
- Covers most parts of Android

Icons taken from Google (Play Store) + Wikimedia
Scope of this Work

component developer

specify usage profile

develop or improve system component

benchmark developer

record app traces

profile

trace pool

mix benchmark

customized benchmark

replay the mixed traces

[insufficient]

quantify improvement

base line result

improved result

improvement

result

result

improved
Outline

✔ Motivation
  ● Trace Recording
  ● Trace Replay
  ● Evaluation
  ● Summary
Trace Recording

- **Usual resources**
  - CPU
  - Network IO → SystemTap
  - File IO → SystemTap
  - GPU
  - Peripherals, e.g., NFC or BT

- **Android-specific Resources**
  - Application’s lifecycle
  - Location Manager
  - Wake Locks
  - Android Services
    - Download Manager
    - Media Player

Icons taken from Google + SystemTap
Trace Replay 1/2

- **Setup**
  - Android application without any special permissions
  - Own remote host for network communication

- **Preprocessing**
  - Create dummy files on internal and external storage
  - Merge and sort events from different files into one file
Trace Replay 2/2

event action pause

causal relation (with unknown delay)
causal relation (?)

Event handling sequence 1

Event handling sequence 2
Evaluation - Setup

- Recorded *Google Maps* for 15 minutes
  - 6.5 min: View streets, and browser arbitrary streets
  - 2 min: Inactivity, closed app, and display turned off
  - 6.5 min: View streets, and browser arbitrary streets
- Replayed the trace, and recorded it again

Icon taken from Google Playstore
Evaluation - Results 1

- Received Data (MB)
- Send Data (MB)

Time (secs)
Evaluation - Results 2

Read Data (MB) vs. Time (secs)

Written Data (MB) vs. Time (secs)

- Recording
- Replay
Summary

- Benchmarks are needed ...
  - for improving the energy efficiency of Android for developers / researchers

A picture of Arnold Schwarzenegger

max. performance

typical usage profile

Record apps during daily use & replay [mixed] traces