

Energy Testing and Optimization of Mobile Applications

Eclipse Testing Day 2013

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25.09.2013

Mobile Devices

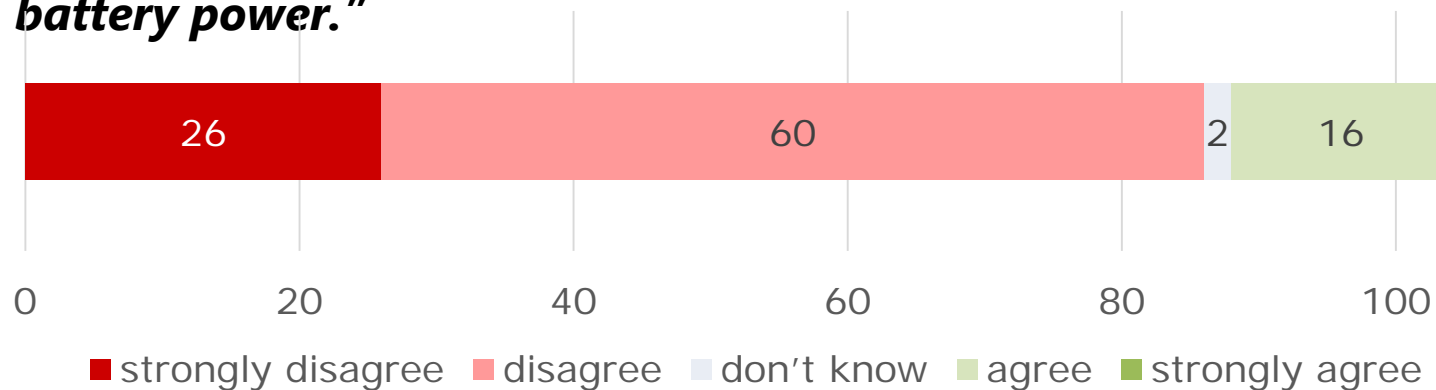


Manufactured	~1850	2011
! Operation time	1–2 days	8 hours (3G)
Services	1	Several thousands (apps)

In Numbers ...



- <http://survey.jouleunit.org/>
- ***“I am satisfied with the operation time of today’s mobile devices while running on battery power.”***



Basis: Online Survey conducted between September 9th and September 19th, 2013 (104 Participants).



“It started to drain the battery and having loooooooooooooong load times. This must be the worst update off all.”

(Glenn)

„Used 5% of my battery within five minutes.”

(Shawn)

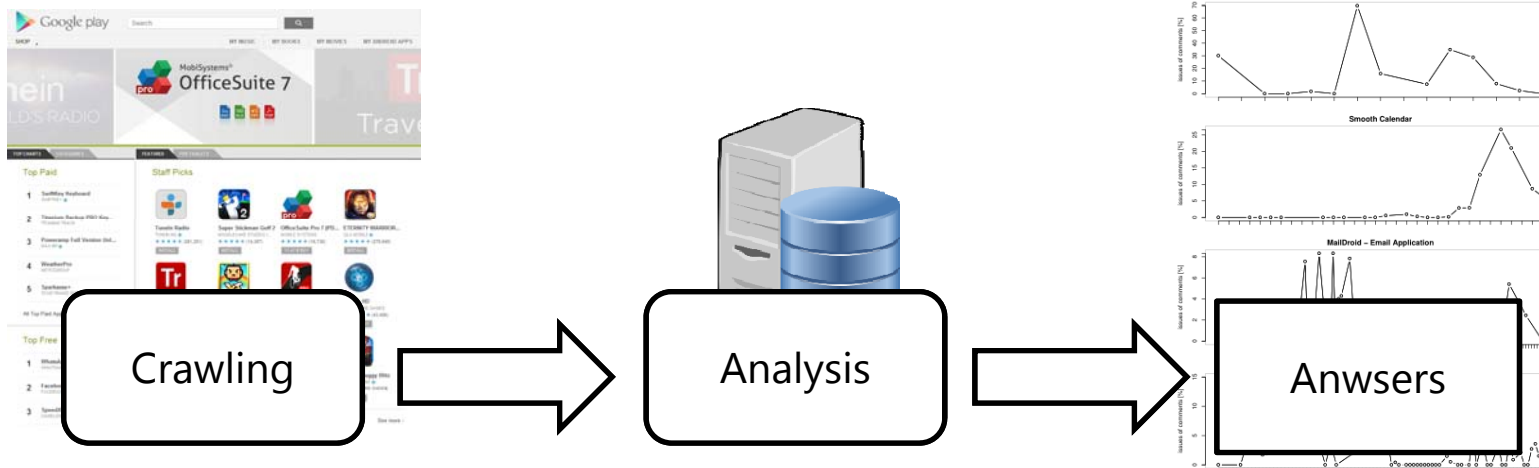


„ I would like to logout during the night so it doesn't kill my battery.”

(Brittany)

Analyzing User Feedback

- **App stores comprise many user comments**
 - Search for complaints about energy-efficiency
 - Analyzing user feedback systematically [WRG+13]

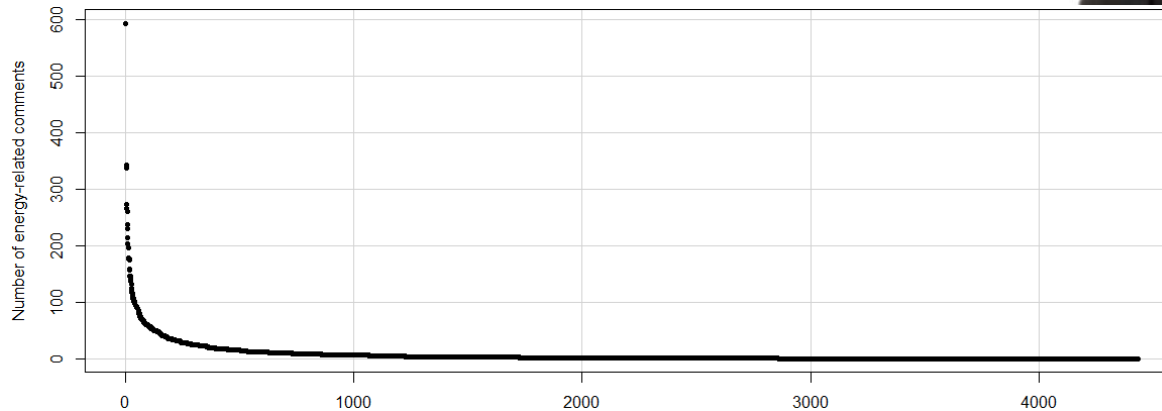


[WRG+13] C. Wilke, S. Richly, S. Götz, C. Piechnick, U. Abmann: *Energy Consumption and Efficiency in Mobile Applications: A User Feedback Study*. In: GreenCom 2013.

Findings (1/3)



- **Every sixth Android app has energy bugs [WRG+13]**



- 18,6% of all apps
- Energy bugs affect grades (-1,8☆)

[WRG+13] C. Wilke, S. Richly, S. Götz, C. Piechnick, U. Abmann: *Energy Consumption and Efficiency in Mobile Applications: A User Feedback Study*. In: GreenCom 2013.

Findings (2/3)

- **Frequent causes for unwanted energy consumption**
 - Unnecessary background activities
 - Faulty synchronization mechanisms
 - Advertisement banners
 - Unnecessary display usage
 - ...

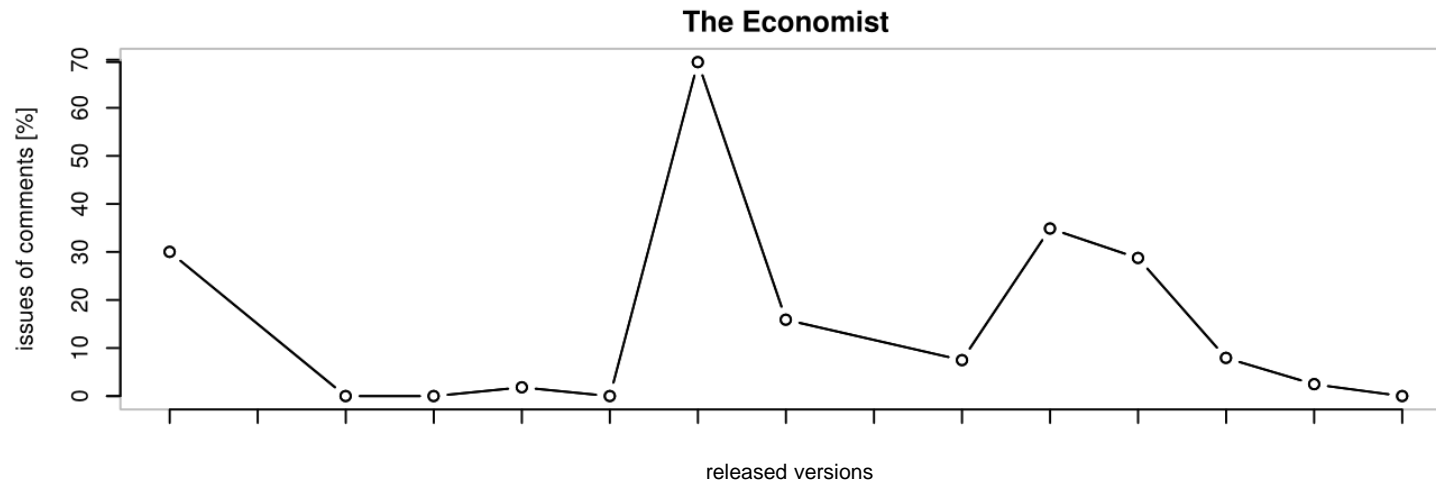
→ **Software bugs**



[WRG+13] C. Wilke, S. Richly, S. Götz, C. Piechnick, U. Abmann: *Energy Consumption and Efficiency in Mobile Applications: A User Feedback Study*. In: GreenCom 2013.

Findings (3/3)

- **Many bugs are introduced by software updates**



[WRG+13] C. Wilke, S. Richly, S. Götz, C. Piechnick, U. Abmann: *Energy Consumption and Efficiency in Mobile Applications: A User Feedback Study*. In: GreenCom 2013.

Conclusion

- 1. Mobile application users dislike energy wastes**
- 2. In several cases, they are caused by faulty software (aka. energy bugs)**

Targets

- 1. Detection and correction of energy bugs**
- 2. Development of energy-aware mobile applications**

Solution: Energy Testing

- **JUnit extension JouleUnit** [WGR13]

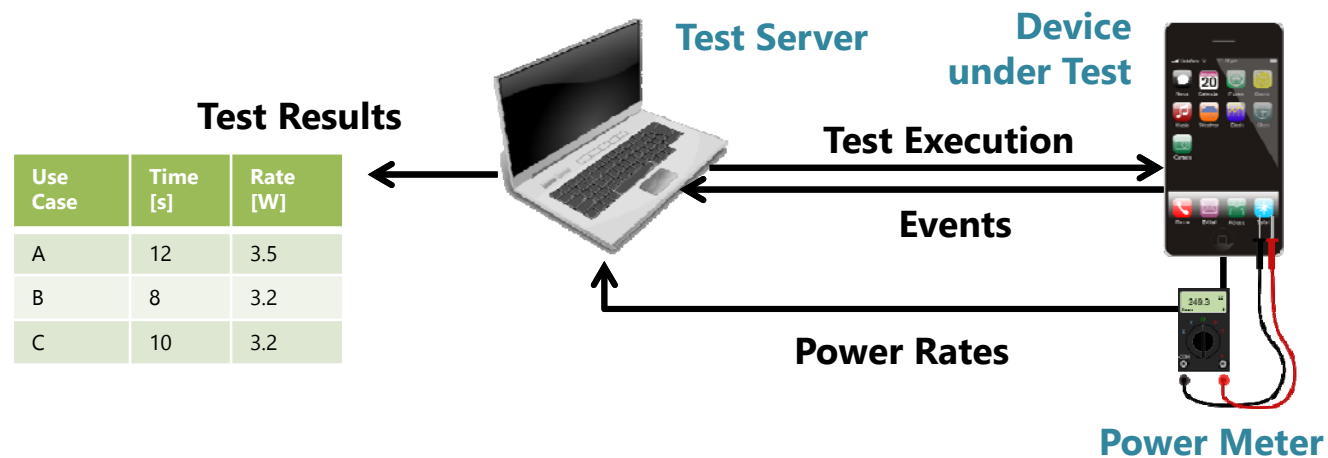
- **Workloads are defined as unit tests:**

```
testSendMail() {  
    robot.enterText("To", "ex@ample.com");  
    robot.enterText("Msg", "Hi Ex, ...");  
    ...  
    robot.clickOnButton("Submit");  
}
```



- **Execution and parallel energy profiling:**
consumption values for use cases or individual method calls
- **Currently support for Android-operated devices**

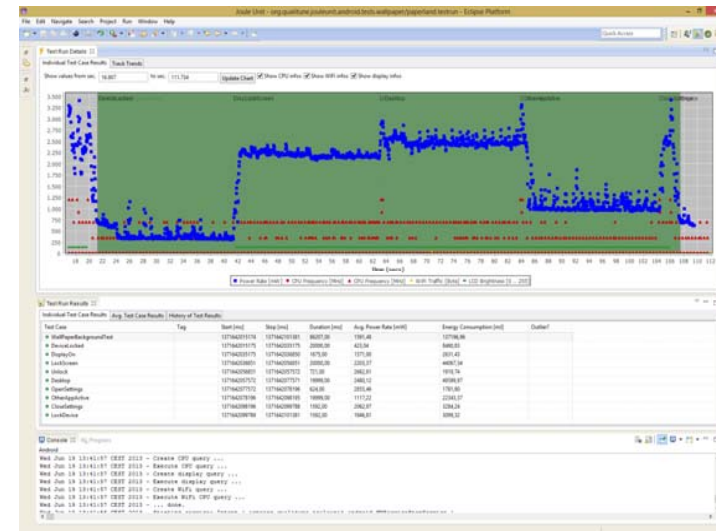
Energy Testing



- **Reproducible test runs**
- **Reuse of functional tests possible**
- **Well-known methodology → low learning curve**

JouleUnit Workbench

- **Constructing and triggering energy tests from Eclipse**
- **Local execution**
 - On testing device or emulator
 - Use of battery API
 - *Coarse-grained results*
- **Remote execution**
 - Deployment of test devices
 - Hardware-based profiling
 - *Fine-grained, accurate results*



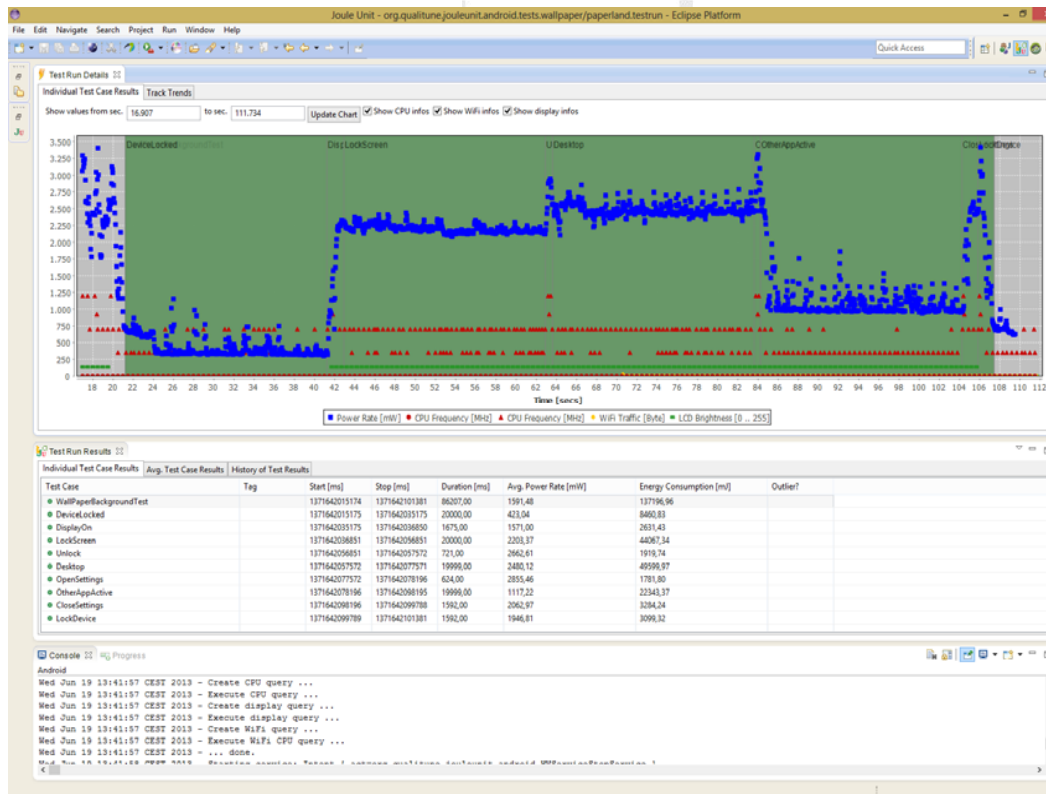
Demo



The Energy-Aware App Store

My Account - Projects - K-9 Mail

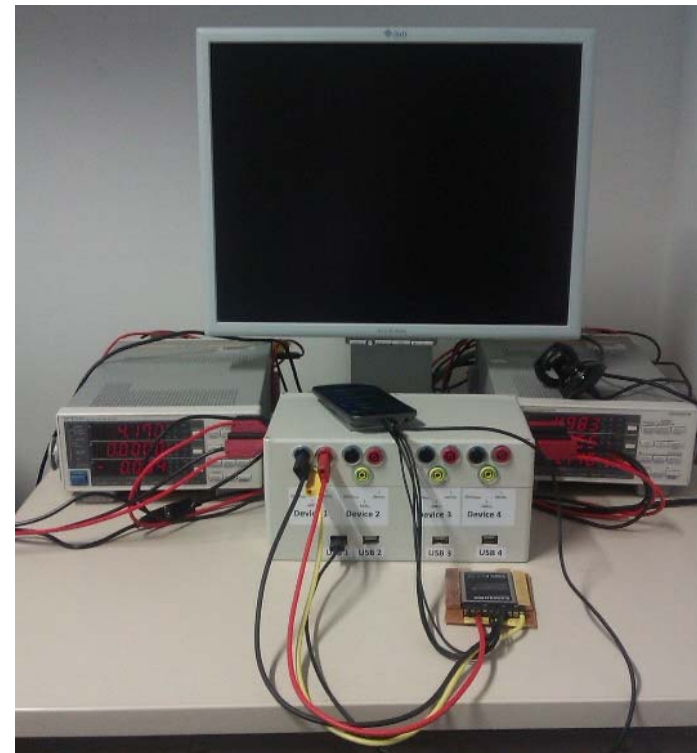
Home - About - Logged in as chuck - My Account - Logout





QMark

- **Energy profiling as a service**
- **Execution on remote test infrastructure**
 - Automated test runs on real Android devices
 - Multiple runs possible
- **Execution & inspection**
 - Web frontend
 - Eclipse client



Possible Use Cases

1. Detection of energy bugs

- Explorative testing / debugging

2. Impact Analysis for new features

- E.g., influence of advertisement

3. Background test

- Consumption of applications in idle modes

4. Energy regression tests

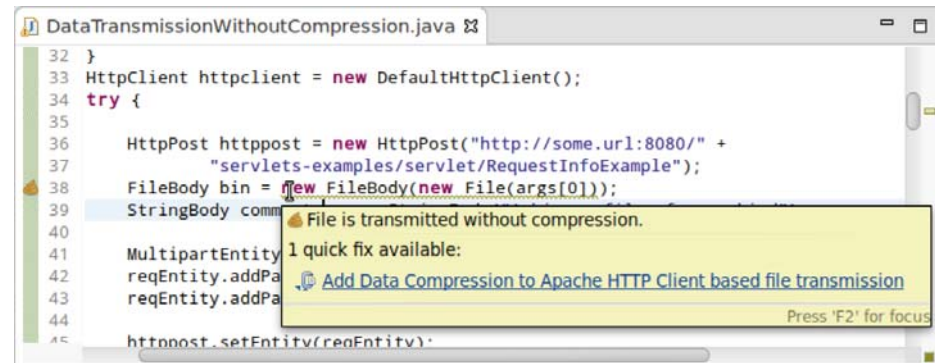
- Detection of energy bugs during continuous integration
- Avoidance of bad updates and software releases

Current Status

- **JouleUnit available open source**
 - Feel free to
 - Download
 - Test
 - Improve
- **Profiling as a Service**
 - First running version online
 - User accounts available soon

Beyond JouleUnit

- **Energy testing is still testing**
 - What can be done beyond testing?
- **Anti-pattern detection**
e.g., wakelocks [PJHM12]
- **Energy refactorings**
correcting anti-patterns
[GJJW12]



The screenshot shows a code editor window titled "DataTransmissionWithoutCompression.java". The code is as follows:

```
32 }
33 HttpClient httpClient = new DefaultHttpClient();
34 try {
35
36     HttpPost httpPost = new HttpPost("http://some.url:8080/" +
37     "servlets-examples/servlet/RequestInfoExample");
38     FileBody bin = new FileBody(new File(args[0]));
39     StringBody comm
40
41     MultipartEntity
42     reqEntity.addPa
43     reqEntity.addPa
44
45     httpPost.setEntity(reqEntity);
```

A yellow warning box is overlaid on the code, containing the text: "File is transmitted without compression. 1 quick fix available: Add Data Compression to Apache HTTP Client based file transmission". The quick fix is a blue link with a small icon to its left. At the bottom right of the warning box, it says "Press 'F2' for focus".

[PJHM12] A. Pathak, A. Jindal, Y. C. Hu, and S. P. Midkiff, "What is keeping my phone awake?: Characterizing and detecting no-sleep energy bugs in smartphone apps," in MobiSys '12. ACM, 2012, pp. 267–280

[GJJW12] Gottschalk, M.; Josefiok, M.; Jelschen, J. & Winter, A. "Removing Energy Code Smells with Reengineering Services ", in EEBs 2012, vol. 208 of LNI, GI, 2012, pp. 441-455

Summary

- **Energy bugs influence usability** and thus, ...
 - User ratings,
 - Downloads,
 - Sells
- **Target: development of energy-aware mobile apps**
 - Unit-test based energy profiling
 - Profiling as a Service
- **Possible use cases**
- **Interested? Call us!**



Thank you!

- **More information:**
 - <http://www.qualitune.org/>
 - <http://www.jouleunit.org/>
- **Contact:** claas.wilke@tu-dresden.de
- **Survey in progress:** <http://survey.jouleunit.org/>



Questions?

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