Mining Energy-Aware Commits

Irineu Moura   Gustavo Pinto   Felipe Ebert   Fernando Castor

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The Problem

- Energy efficiency is becoming a key design consideration.

- A large body of work in hardware/architecture, operating systems, runtime systems.

The Problem

- Energy efficiency is becoming a key design consideration.

- A large body of work in hardware/architecture, operating systems, runtime systems.

- However, little is known about the application level.

- Little is known about what are the **solutions** that programmers actually **use** to mitigate this problem.

4Mi+ Users

19Mi+ Repositories

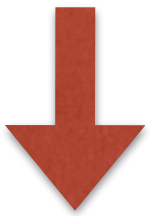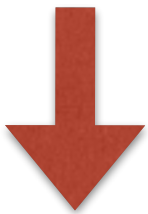"GitHub is the largest code host on the planet with over 19.9 mi repositories."
https://github.com/features

19M Repos

19M Repos

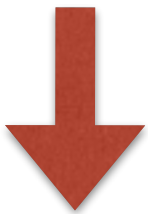**Query on**

GitHub Archive

19M Repos

Query on **GitHub** Archive

```sql
SELECT (repository_url + '/commit/' + payload_commit_id) as commit_link, repository_url,
       repository_owner, repository_name, payload_commit_id, payload_commit_email,
       payload_commit_msg,  payload_commit_name, payload_commit_flag, created_at
       FROM [githubarchive:github.timeline]
       WHERE payload_commit_msg is not null
       AND PARSE_UTC_USEC(created_at) <= PARSE_UTC_USEC ('2014-05-15 23:59:59')
       AND (lower(payload_commit_msg) like '%power consum%'
           OR lower(payload_commit_msg) like '%power efficien%'
           OR lower(payload_commit_msg) like '%power sav%'
           OR lower(payload_commit_msg) like '%save power%'
           OR lower(payload_commit_msg) like '%energy consum%'
           OR lower(payload_commit_msg) like '%energy efficien%'
           OR lower(payload_commit_msg) like '%energy sav%'
           OR lower(payload_commit_msg) like '%save energy%')
       AND type = 'PushEvent'
       GROUP BY commit_link, payload_commit_msg, repository_url, payload_commit_id,
               created_at, repository_owner, repository_name, payload_commit_email,
               payload_commit_name, payload_commit_flag

       ORDER BY created_at asc
```
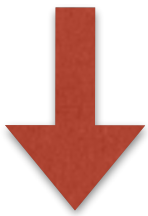
19M Repos

Query on
GitHub Archive

2,189 Commits

```sql
SELECT (repository_url + '/commit/' + payload_commit_id) as commit_link, repository_url,
    repository_owner, repository_name, payload_commit_id, payload_commit_email,
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    ORDER BY created_at asc
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19M Repos
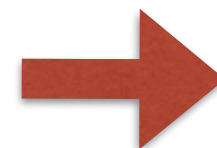
Query on
GitHub Archive

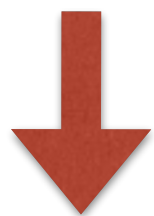Automatic Filter

1,005 Commits

19M Repos

Query on
GitHub Archive

Automatic Filter

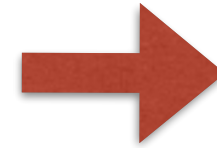Manual Filter

19M Repos

Commits
dh7h3
md8ja
j287h
dij873
dj827h
os837
82uan
28a08
2ja82
d0hk0
j29yd
a7jf9
aio92
hnna2

Automatic Filter

Manual Filter

19M Repos

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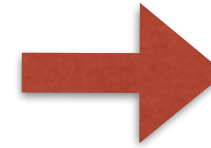
Automatic Filter

Manual Filter

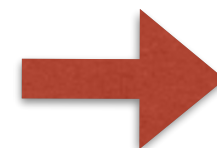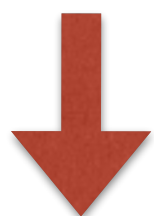| Commits |
| --- |
| dh7h3 |
| md8ja |
| j287h |
| dij873 |
| dj827h |
| os837 |
| 82uan |
| 28a08 |
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19M Repos

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All commits were, at least, double-checked!

19M Repos

Query on **GitHub Archive**

Automatic Filter

Manual Filter

371 Energy-Aware Commits

371 Energy-Aware Commits

- From 03/12/2012 to 05/15/2014

- Performed into 317 OSS Projects

- Performed by 265 OSS Developers

Metric	Mean	Median	Standard Dev.	Histogram
LoC	4,069,000	68,930	5,239,099	
Contributors	202.3	6.5	335.31	
Commits	68,250	475.5	126,104	
Age	4.50	3	3.72	

Research Questions

- **RQ1.** What are the **solutions** that developers use to save energy in practice?

- **RQ2.** What software **quality attributes** may be given precedence over energy consumption?

- **RQ3.** How are energy-saving solutions distributed over the **software stack**?

- **RQ4.** To what extent are software developers **certain** that their commits will save energy?

RQ1: Solutions

- Frequency and voltage scaling (50 occurrences)

- Use power efficient library/device (45 occurrences)

- Disabling features or devices (42 occurrences)

- Energy bug fix (26 occurrences)

- Low power idling (22 occurrences)

- Timing out (16 occurrences)

RQ1: Solutions

- Frequency and voltage scaling (50 occurrences)

Reduce Wifi voltage for power savings

Should be beneficial for a wifi only device

Browse files

⎇ 10.1

Metallice authored on Jun 27, 2012   1 parent 3cee2da   commit 34f4738019a9e04c882ffa05bed1b40b81017c51

Showing **1 changed file** with **1 addition** and **1 deletion**.   Unified   Split

2 ■■■ arch/arm/mach-omap2/board-espresso-wifi.c   View

```
@@ -230,7 +230,7 @@ static struct regulator_init_data espresso_vmmc5 = {
230   230
231   231        static struct fixed_voltage_config espresso_vwlan = {
232   232            .supply_name       = "vwl1271",
233       -        .microvolts        = 2000000, /* 2.0V */
      233   +        .microvolts        = 1800000, /* 2.0V */ /*1.8V Metallice*/
234   234            .startup_delay     = 70000, /* 70msec */
235   235            .enable_high       = 1,
236   236            .enabled_at_boot   = 0,
```

19

RQ1: Solutions

- Use power efficient library/device (45 occurrences)

TEST: WCD9310: Use power efficient workqueue   Browse files

Convert our WCD9310 codec to use the new power efficient workqueue
offered by newer kernels.

⑂ master

🔲 **yseras** authored on Feb 17, 2014   1 parent **08a755b** commit 7618d681692c6ae1508bd981c7bc837b8f2bc334

⊞ Showing **1 changed file** with **4 additions** and **4 deletions**.   Unified   Split

8 ▆▆▆▆ sound/soc/codecs/wcd9310.c   View

```
@@ -2912,7 +2912,7 @@ static int tabla_codec_enable_dec(struct snd_soc_dapm_widget *w,
2912  2912                    if (tx_hpf_work[decimator - 1].tx_hpf_cut_of_freq !=
2913  2913                                    CF_MIN_3DB_150HZ) {
2914  2914
2915       -                     schedule_delayed_work(&tx_hpf_work[decimator - 1].dwork,
      2915  +                     queue_delayed_work(system_power_efficient_wq, &tx_hpf_work[decimator - 1].dwork,
2916  2916                                    msecs_to_jiffies(300));
2917  2917                    }
```

20

RQ2: Quality Attributes

- Correctness (7 occurrences)

- Responsiveness (6 occurrences)

- Performance (3 occurrences)

- No actual power saving (3 occurrences)

- Miscellaneous (3 occurrences)

RQ2: Quality Attributes

- Correctness (7 occurrences)

semi working - sensors read out, but bad radio   Browse files

Quashed compile bug and redid some documentation, but radio does not
transmit proper values — it probably can't handle the array in the
typedef struct. will have to fix that. the sensors scan fine and write
correctly to the array (varified by serial output) — also, the power
saving delay has the ability to corrupt serial transmissions. changing
these to regular delays fixes this. — getting there!

master (#4)

Teslafly authored on Apr 19, 2014   1 parent b5bc8fa   commit 659afda362c0e0a23dc36d6f56fa0aab83812c91

RQ2: Quality Attributes

- Responsiveness (6 occurrences)

cpufreq: boost the sampling rate on touch event　　　　Browse files

For better Ux responsiveness ondemand sampling rate
needs to be 20ms. But, a 20ms sampling rate increases power
consumption. So, boost the sampling rate to 20ms on every
touch event for 2.5 ms and later reset to default rate.
Also, change sampling down factor proportional to the
sampling rate.

Change-Id: I111b1cf3b8ed133347149afc34d329d0384ecfcb
Signed-off-by: Narayanan Gopalakrishnan <nargop@codeaurora.org>

cm-10.1_3.0 + jellybean + jellybean-stable + mr1-staging

Narayanan Gopalakrishnan authored on Aug 9, 2012   1 parent b56043a   commit 694447e65dd4af2af7193021ab67c4cad91ff412
→ intervigilium committed on Oct 5, 2012

RQ3: Software Stack
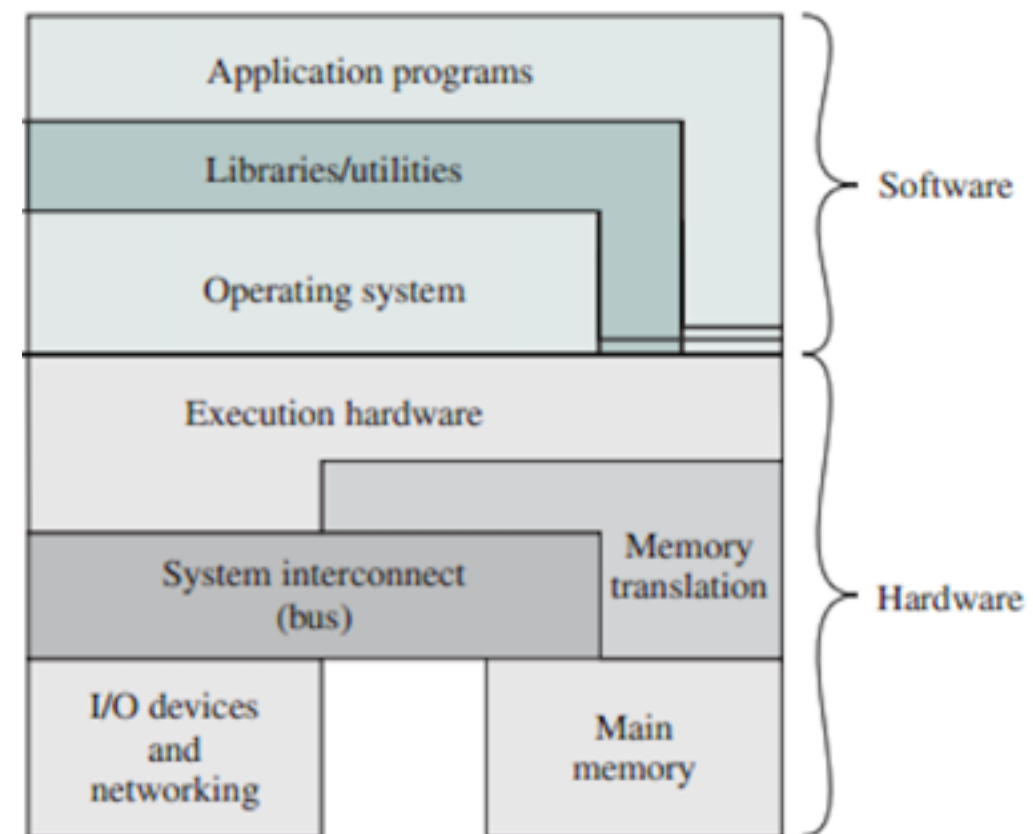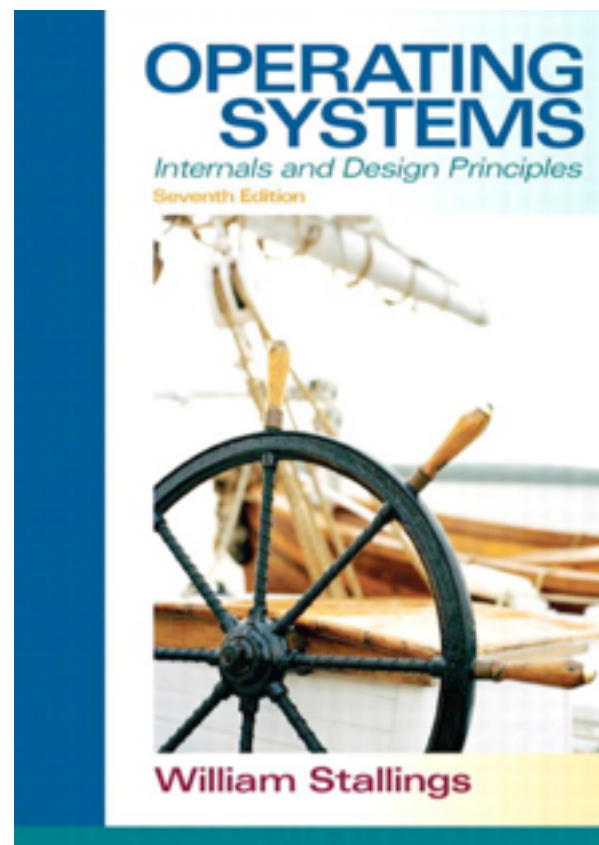
RQ3: Software Stack

88 Commits ⬅

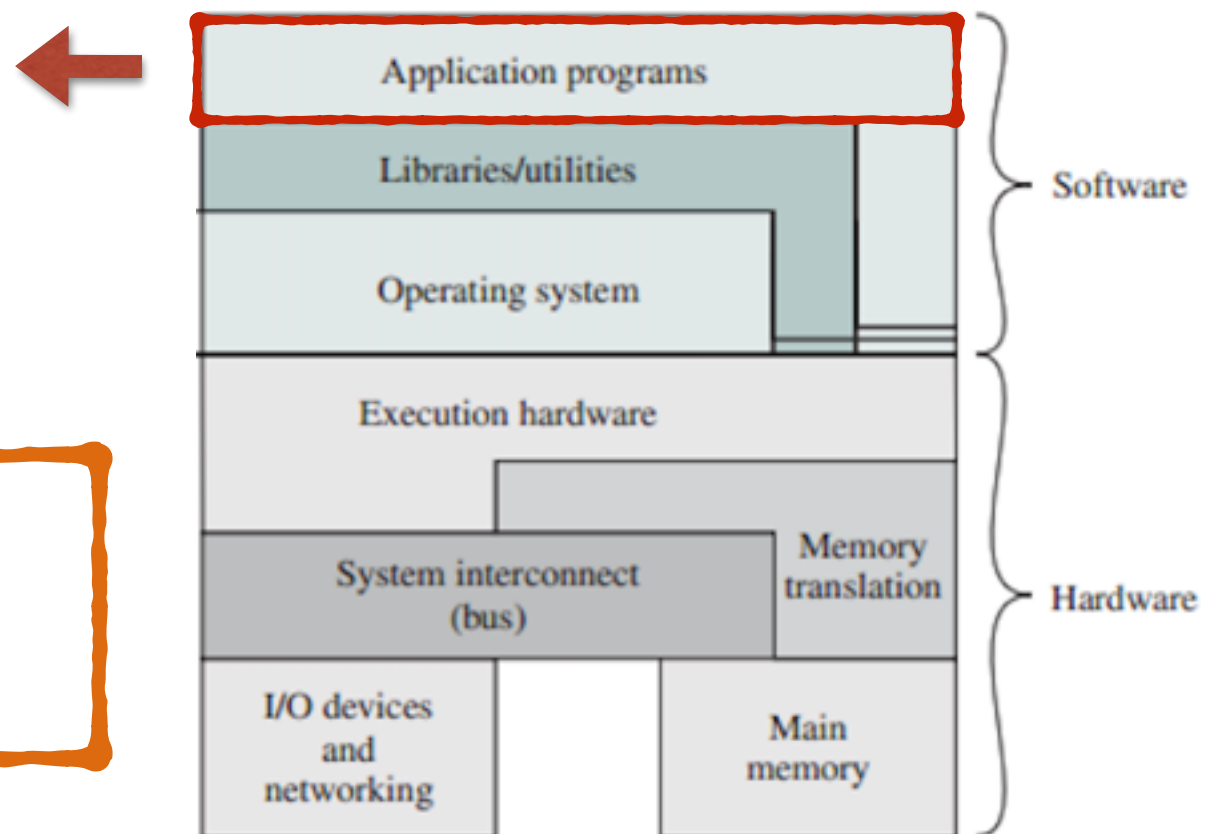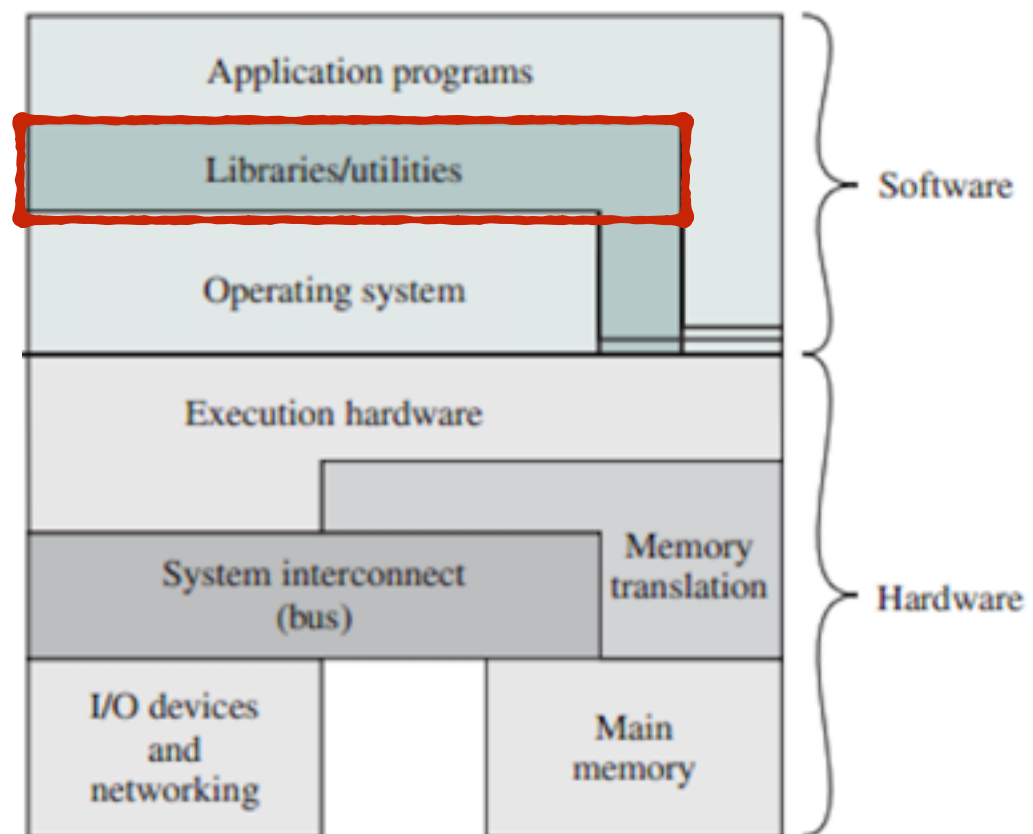Application includes embedded applications, desktop application, and mobile applications.

Application programs

Libraries/utilities

Operating system

Software

Execution hardware

System interconnect (bus)

Memory translation

Hardware

I/O devices and networking

Main memory

OPERATING SYSTEMS
Internals and Design Principles
Seventh Edition

William Stallings
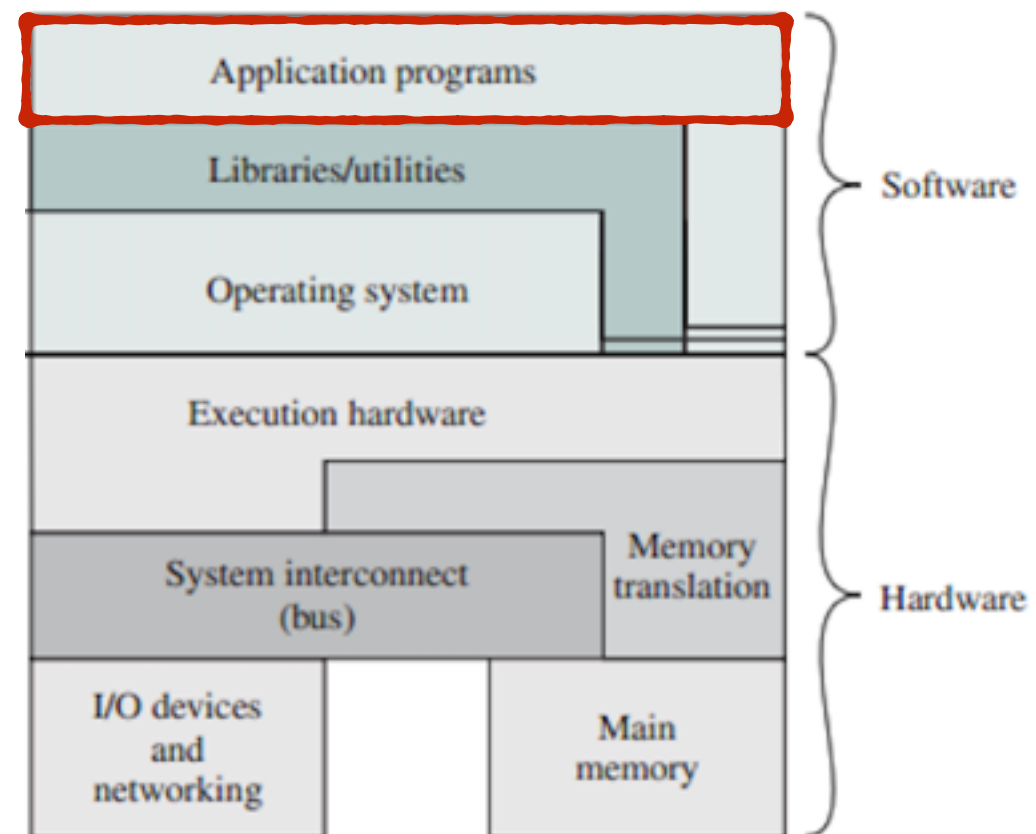
RQ3: Software Stack

88 Commits

42 Embedded

Application includes embedded applications, desktop application, and mobile applications.
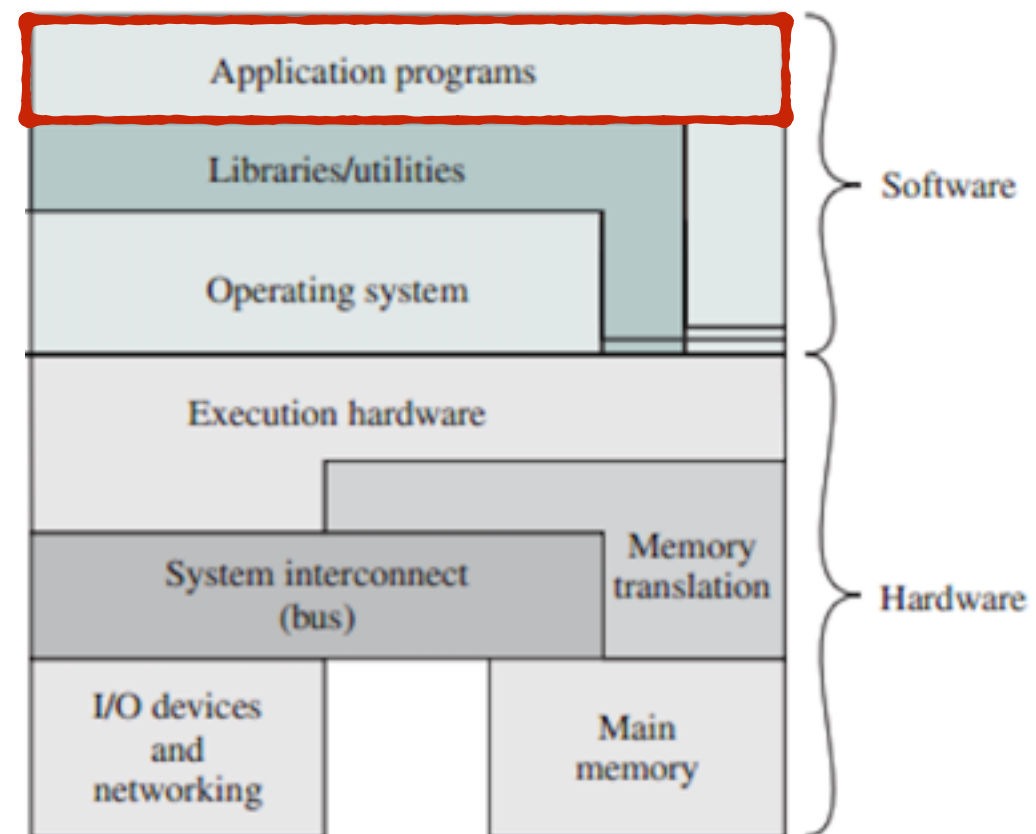
RQ3: Software Stack

88 Commits

42 Embedded

21 Arduino

Application includes embedded applications, desktop application, and mobile applications.

Application programs		Software
Libraries/utilities		
Operating system		
Execution hardware		Hardware
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OPERATING SYSTEMS
Internals and Design Principles
Seventh Edition

William Stallings

RQ3: Software Stack

50 Commits

Libraries/Utilities include scripts and embedded libraries.

RQ3: Software Stack

50 Commits

41 scripts

Libraries/Utilities include scripts and embedded libraries.

RQ3: Software Stack

142 Commits

Operating System includes Kernels, Embedded Kernels, Drivers and Firmwares
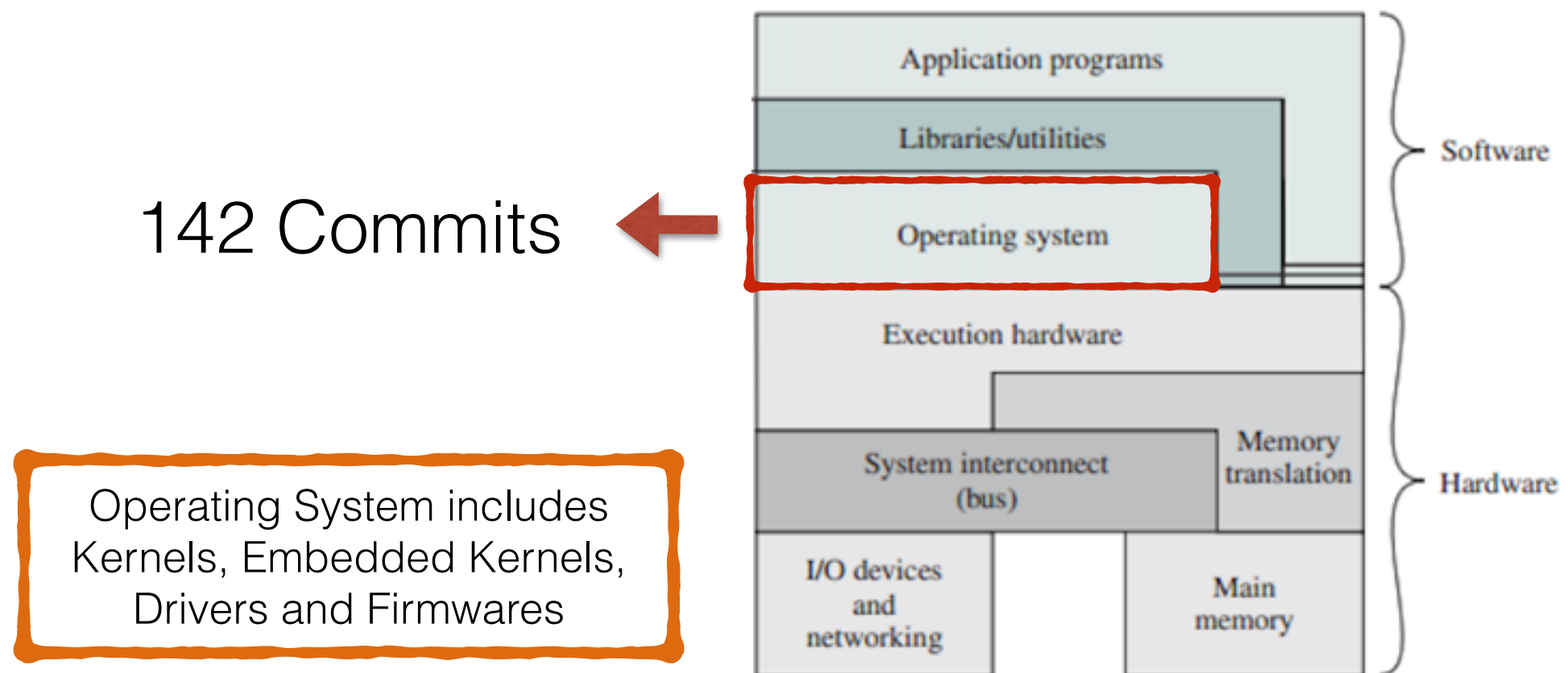
RQ3: Software Stack

142 Commits

69 Kernels

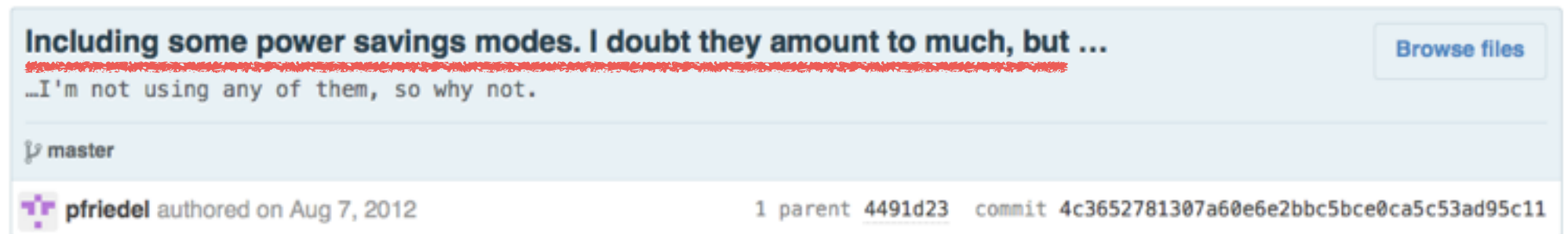Operating System includes Kernels, Embedded Kernels, Drivers and Firmwares
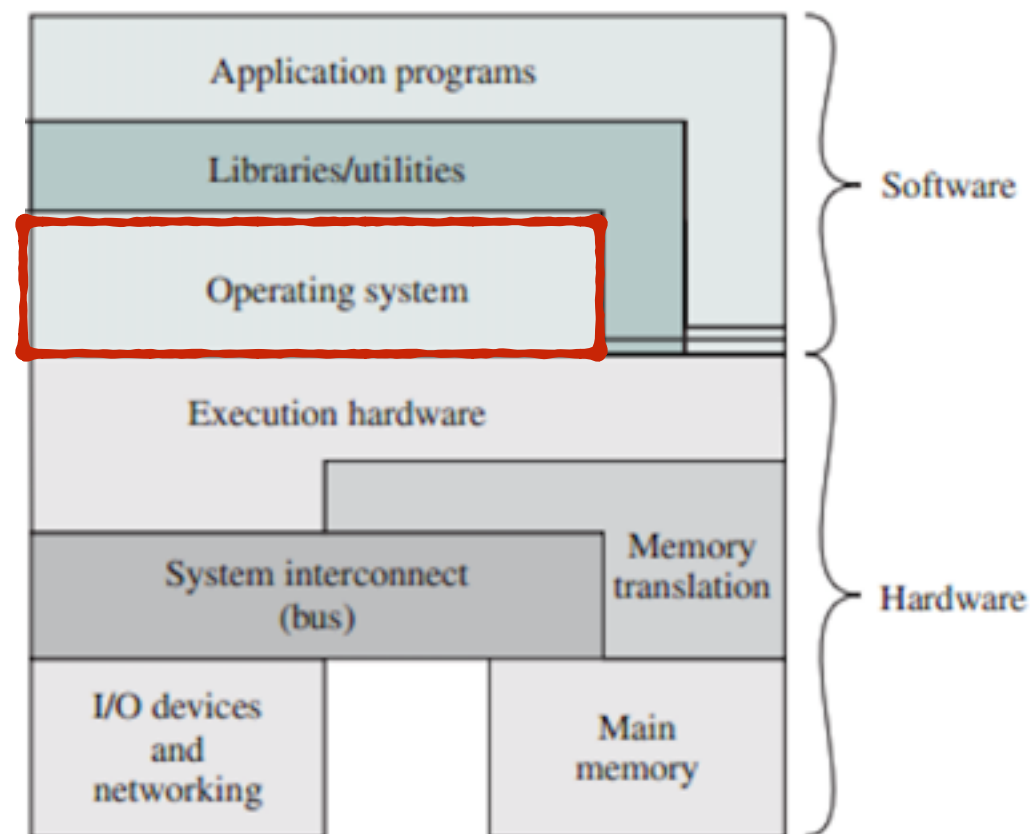
RQ3: Software Stack

142 Commits

69 Kernels

54 Drivers

Operating System includes Kernels, Embedded Kernels, Drivers and Firmwares

Application programs

Libraries/utilities

Operating system

} Software

Execution hardware

System interconnect (bus)

Memory translation

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OPERATING SYSTEMS
Internals and Design Principles
Seventh Edition

William Stallings
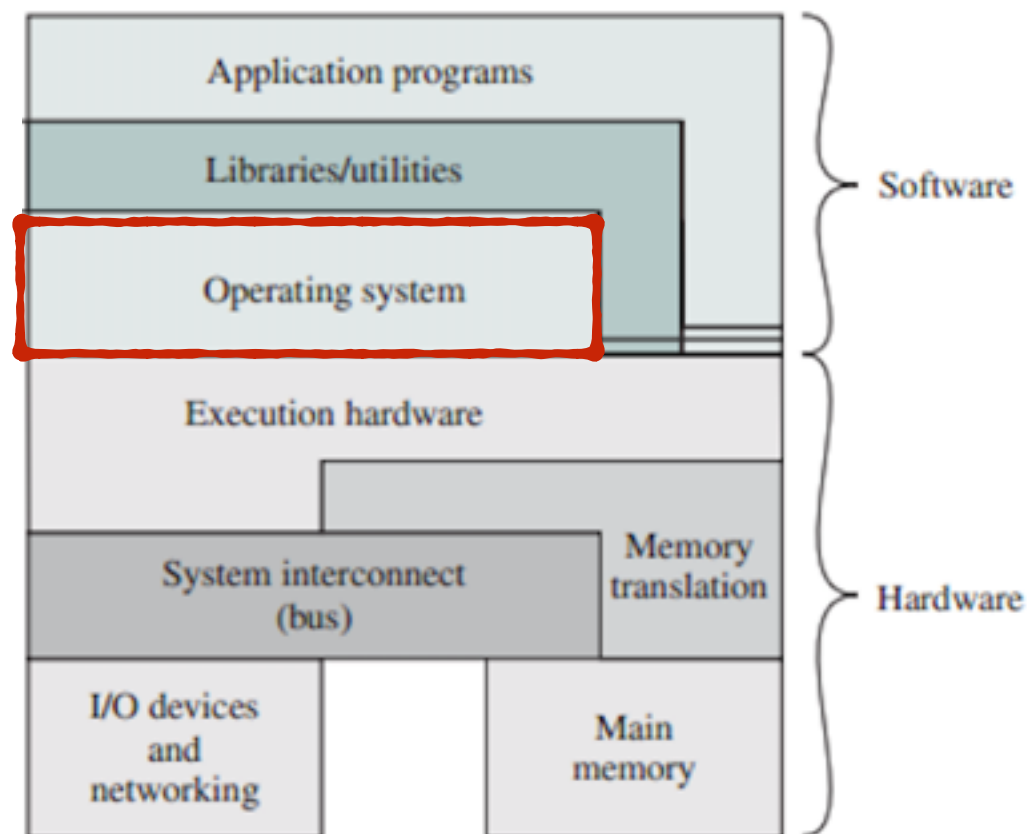
RQ4: Certain

"Hesitating" words

- seem
- might
- doubt
- could
- hope
- attempt
- supposed
- guess
- likely

RQ4: Certain

"Hesitating" words   18 hesitations!

- seem
- might
- doubt
- could
- hope
- attempt
- supposed
- guess
- likely

Including some power savings modes. I doubt they amount to much, but …

…I'm not using any of them, so why not.

master

pfriedel authored on Aug 7, 2012   1 parent 4491d23 commit 4c3652781307a60e6e2bbc5bce0ca5c53ad95c11
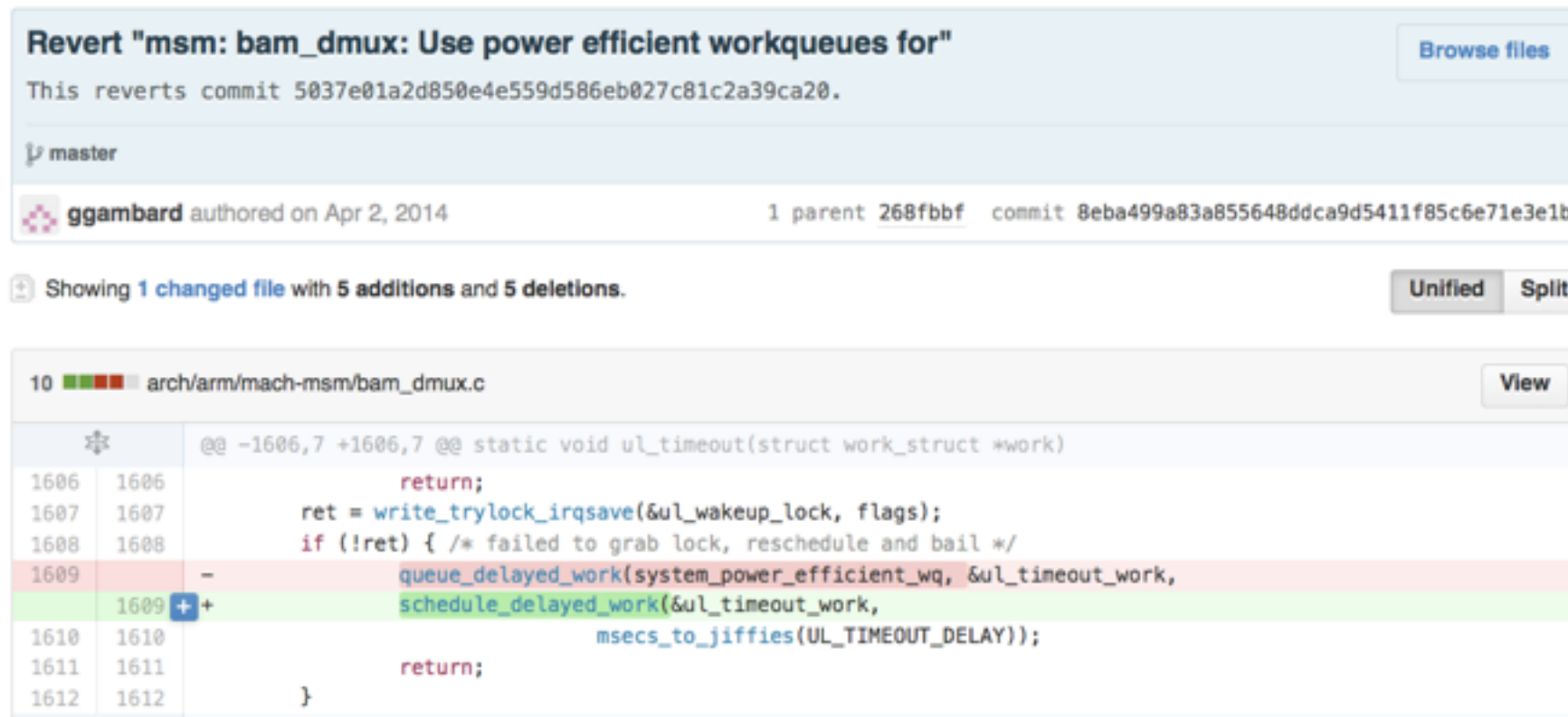
Browse files

RQ4: Certain

18 Reverted Commits

RQ4: Certain

18 Reverted Commits

8/18 reverts the power efficient work queue!

RQ4: Certain

18 Reverted Commits

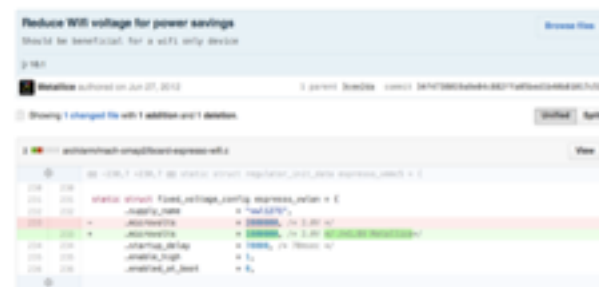8/18 reverts the power efficient work queue!

There is no silver bullet!

Fred Brooks

Conclusions

RQ1: Solutions

- Frequency and voltage scaling (50 occurrences)
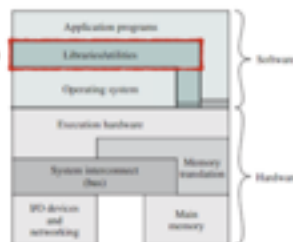
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RQ3: Software Stack

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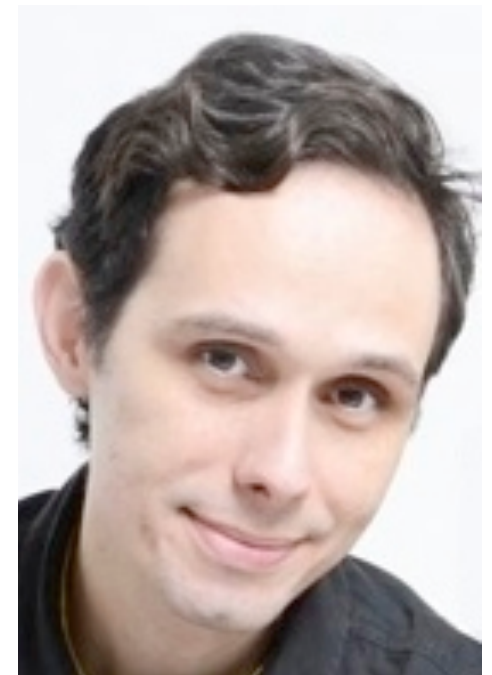
RQ4: Certain

"Hesitating" words

- seem
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- ...

bit.ly/energy-aware-mining

Mining Energy-Aware Commits

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