# Efficient Computing in a Safe Environment

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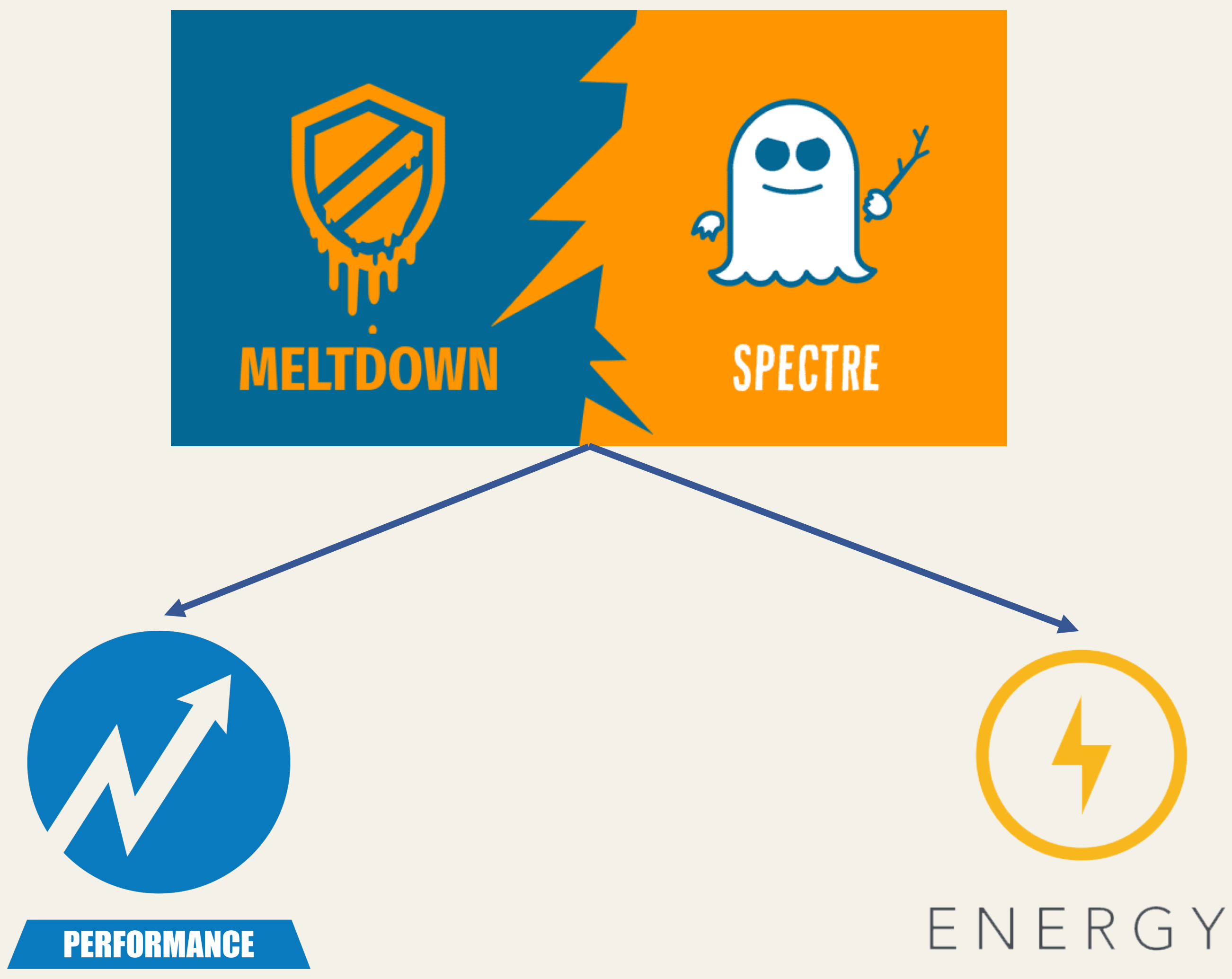
## Introduction

A Study on Energy and Run-Time Performance impact of Spectre and Meltdown mitigation patches to determine whether it is worth it disabling them in a safe environment.



*"When performance goes down by 50% on some loads, people need to start asking themselves whether it was worth it."*

*Linus Torvalds*

## Research Questions

**RQ1:** *What are the energy and run-time performance implications of Meltdown and Spectre mitigation mechanisms?*

**RQ2:** *Which application type's energy and run-time performance are affected more from Meltdown and Spectre mitigation mechanisms?*

## Benchmarks

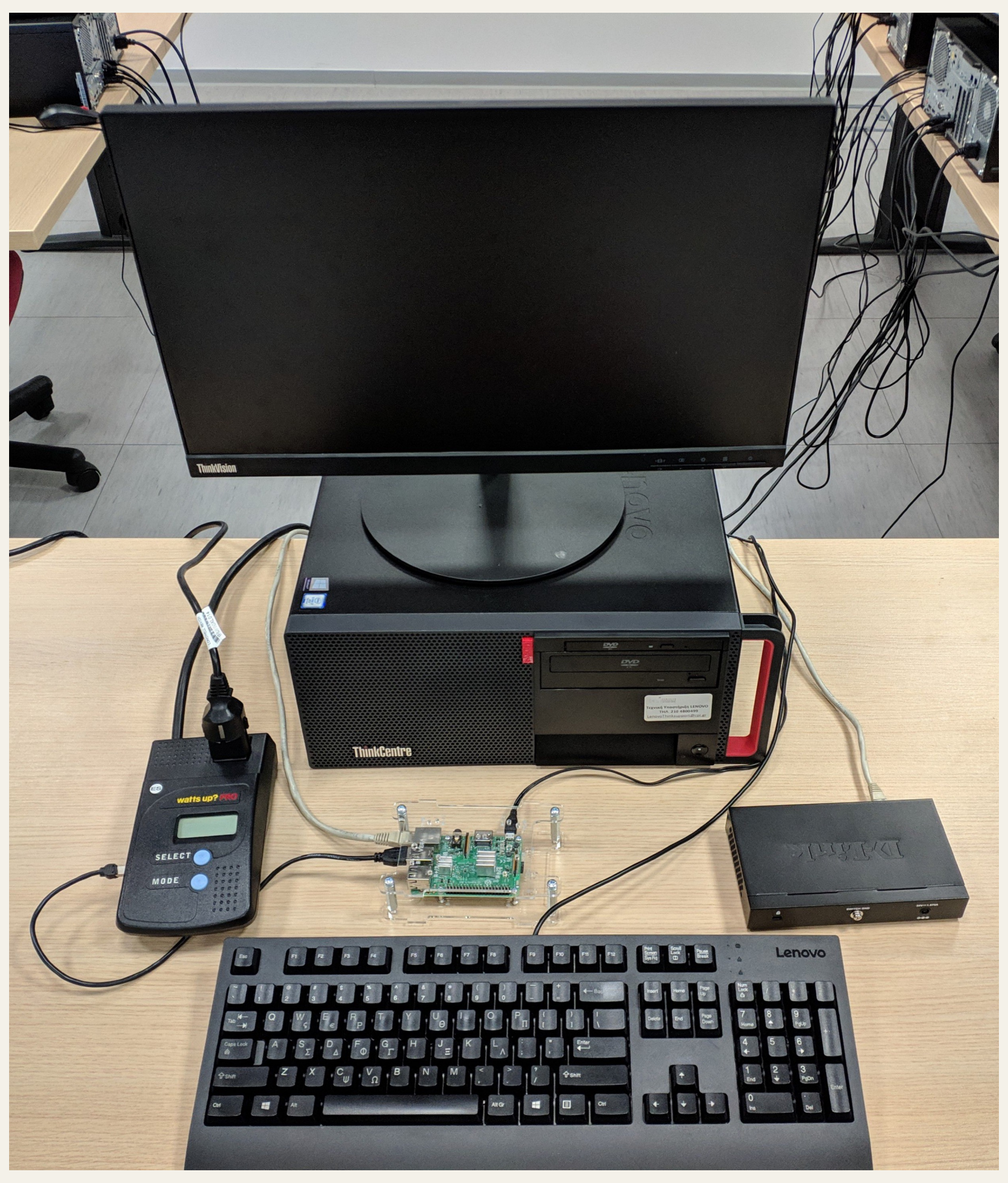
We selected benchmarks from the ***Phoronix Test Suite*** to stress a different functionality in a computer system.

**Phoronix Benchmarks**

| Benchmark Type | Operation(s) |
|---|---|
| Apache & Nginx | AB Apache Command |
| OpenSSL | aes, blowfish, camellia, cast, idea, dsa, ecdsa, ghash, hmac, whirlpool |
| OS Bench | create files, create processes, create threads, launch programs, mem_alloc |
| CacheBench | memcpy, memset, mixed, read, write |
| MC Perf | add, append, delete, get, prepend, replace, set |

## Setup - Methods

### Experimental Platform



We performed our experiments on:

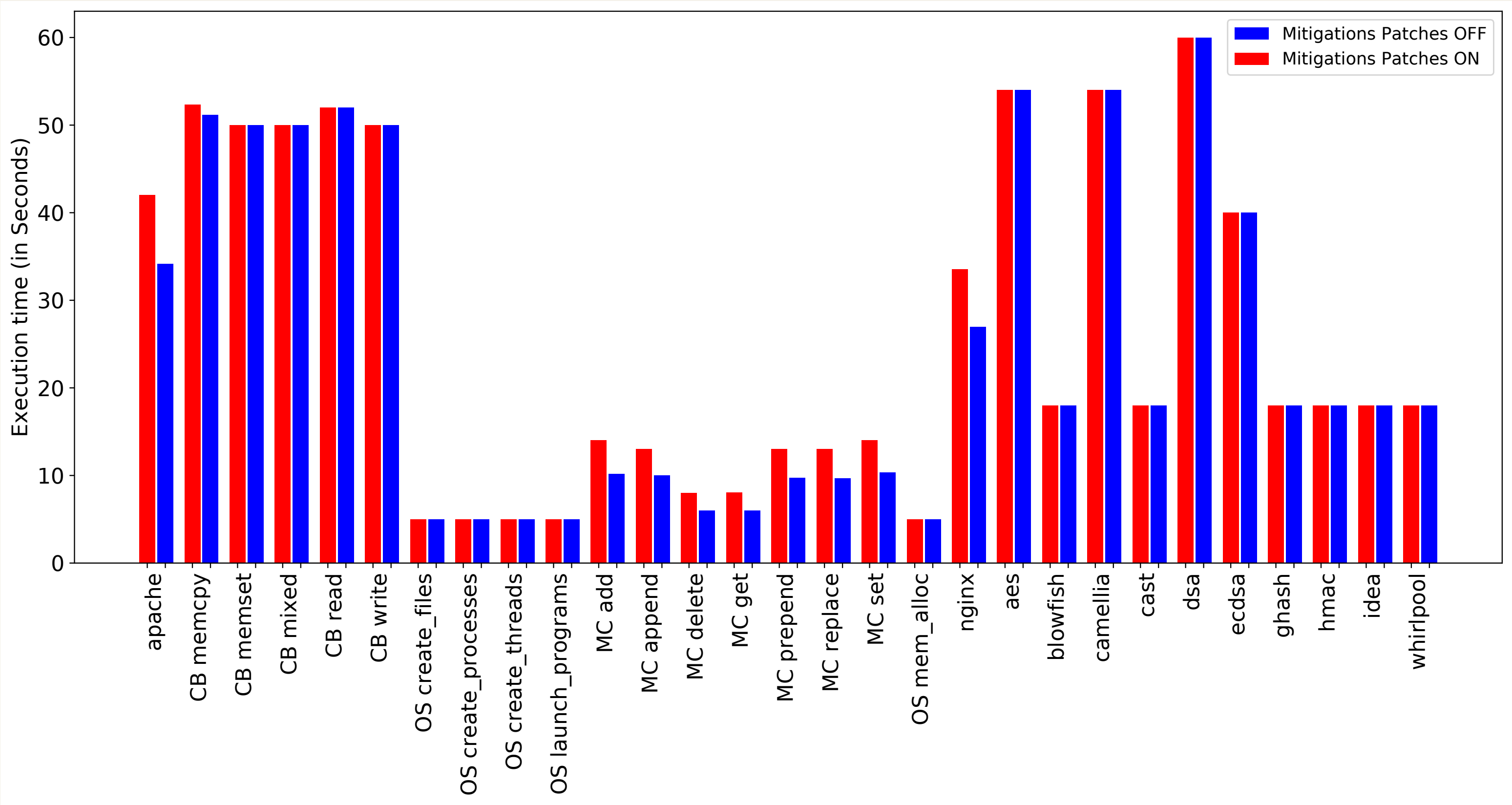
- Lenovo ThinkCentre M910t.
- Fedora 28 and Linux Kernel 5.0.9-100.
- Watts Up Pro (WUP).
- Raspberry Pi 3B.

### Running Experiments

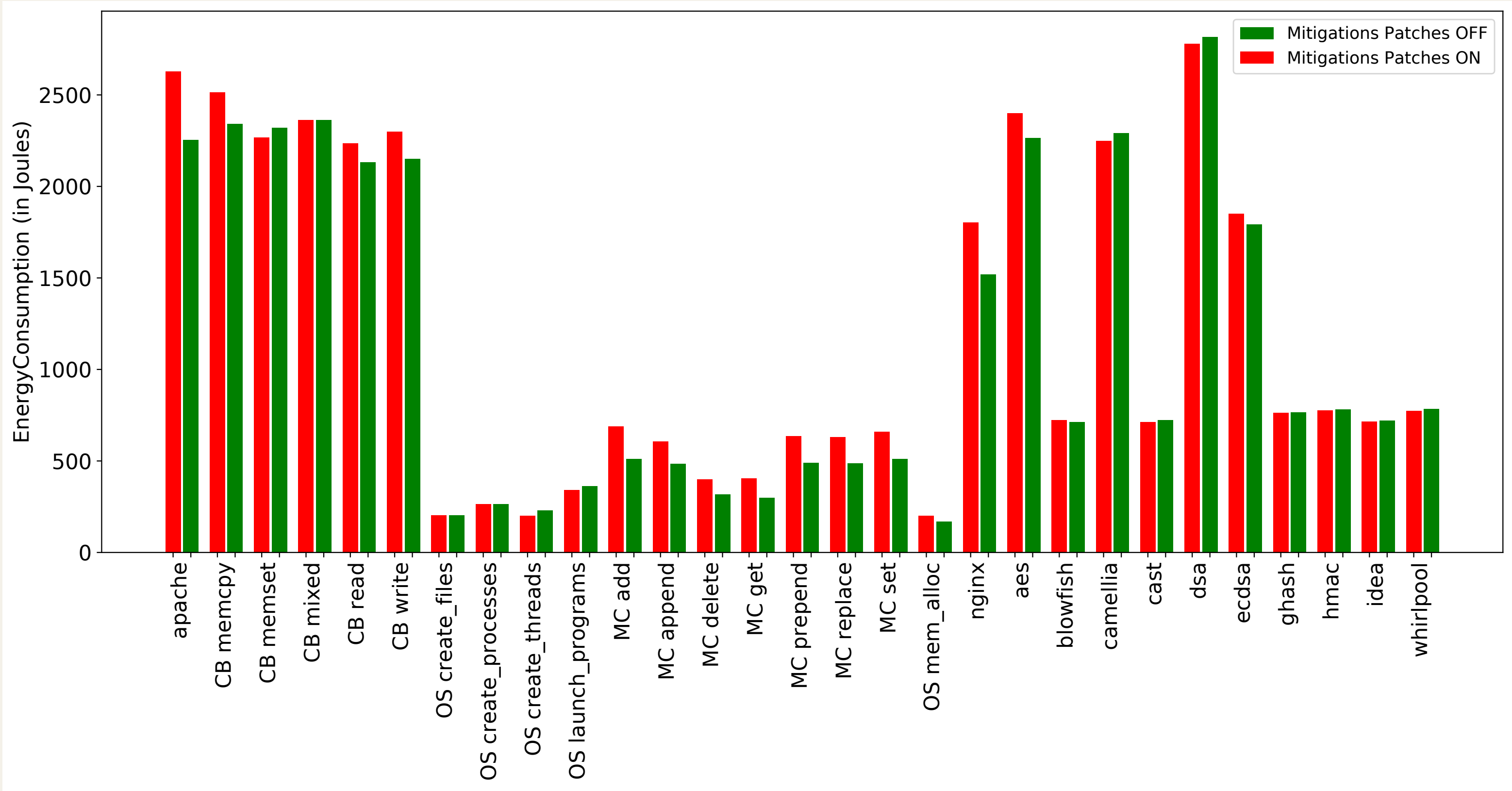
Before running our experiments we took a number of precautions to ensure the validity of our results:

- We shut down background processes and daemons.
- We let a small time window of 30" between each test to avoid power tails.
- We executed each test case 20 times to be statistically correct.

## Results



**[ Meltdown & Spectre benchmarks execution time ]**



**[ Meltdown & Spectre benchmarks energy consumption ]**

## Conclusion

- **RQ1 →** Higher energy consumption and run-time performance overhead of up to **26%** and **27%** respectively.
- **RQ2 →** *Apache* and *Nginx* were both affected by high energy consumption and run-time performance overhead similarly to memory-like operations such as *memcpy, memset, read, write, add, append, replace, set and mem_alloc*. By examining the cryptographic algorithms we experience up to **17%** of increased throughput. Finally, we observe that processes, files and thread creation were not affected by Spectre and Meltdown.

## Acknowledgements

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