

Revisiting Effects of Spectre-Meltdown Security Patches (Paper #16)

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Patches and Possible effects

- Security patches have potential performance effects
- Concerns with Spectre-Meltdown fixes
- Previous works showed performance effects were small
- We showed relative effects on the system in term of Top-Down metrics

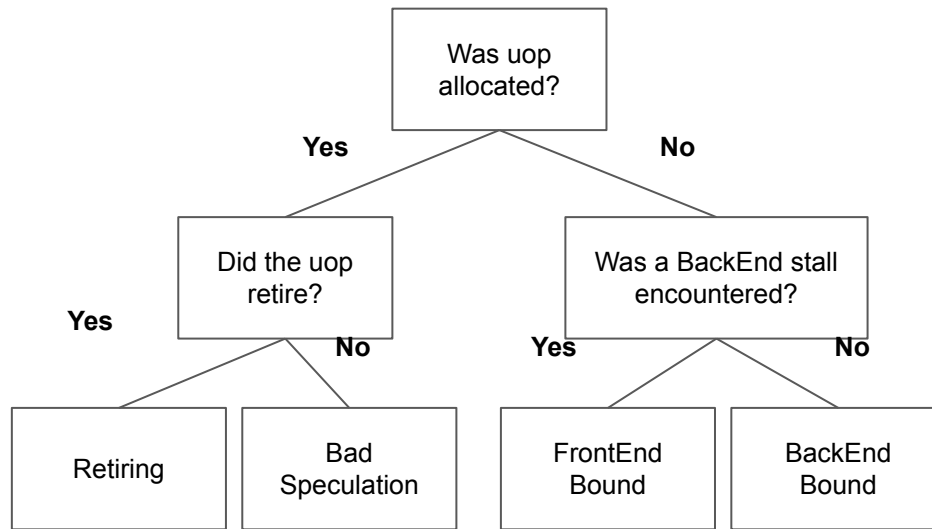
Spectre/Meltdown Attacks

- Meltdown
- Spectre

Effect of Security Fixes

- Permanent patch
 - spectre Variant 1
- dynamic patches
 - Spectre Variant 2
 - Meltdown, variant 3

The Top Down Method



Purchasing Power Parity

- It's been used to compare different currencies
- Most notable example is the Big Mac Index.
 - Big Mac comparison: in the US (\$3.57) and Brazil (7.50 Reales).
 - 1.58 is the currency exchange rate.
 - $7.50 / 3.57 = 2.10$
 - $(2.10 - 1.58) * 100 / 1.58 = 32.91\%$

Purchasing Power Parity

- . In terms of PPP, currencies can be
 - . Overvalued
 - . Undervalued

Purchasing Power Parity

$$PPP_Exchange_Rate = CPU_clk / CPU_clk_{baseline} \quad (3)$$

$$PPP = 100 * ((Metric / Metric_{baseline}) - PPP_Exchange_Rate) / PPP_Exchange_Rate \quad (4)$$

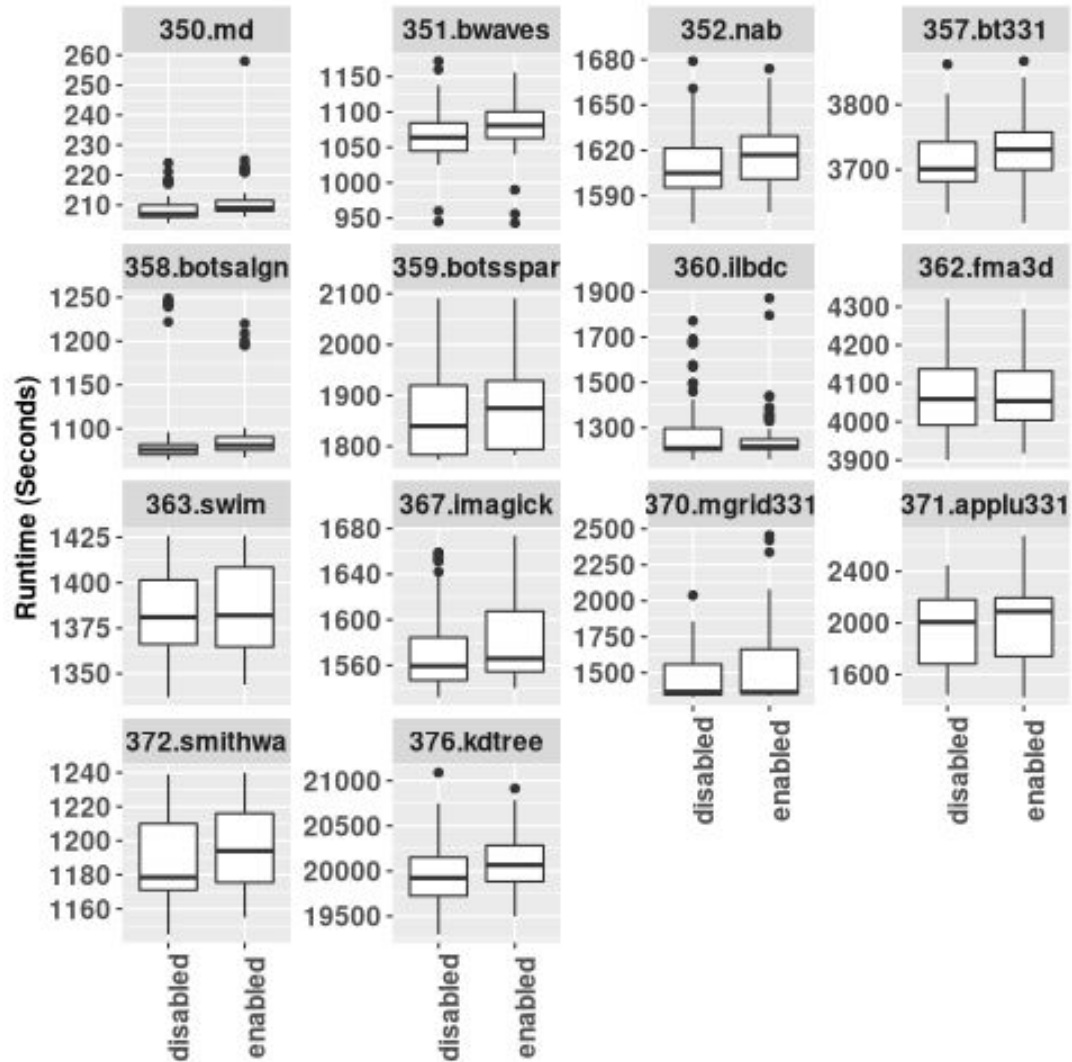
Purchasing Power Parity

- When PPP is applied to performance metrics
 - Currency can be number of cycles
 - Product is a performance metric
 - PPP normalized percentage rates
 - Can be close to 0%
 - Be negative
 - more cpu cycles required when compared to the the baseline
 - Be positive
 - fewer CPU cycles required when compared to the baseline

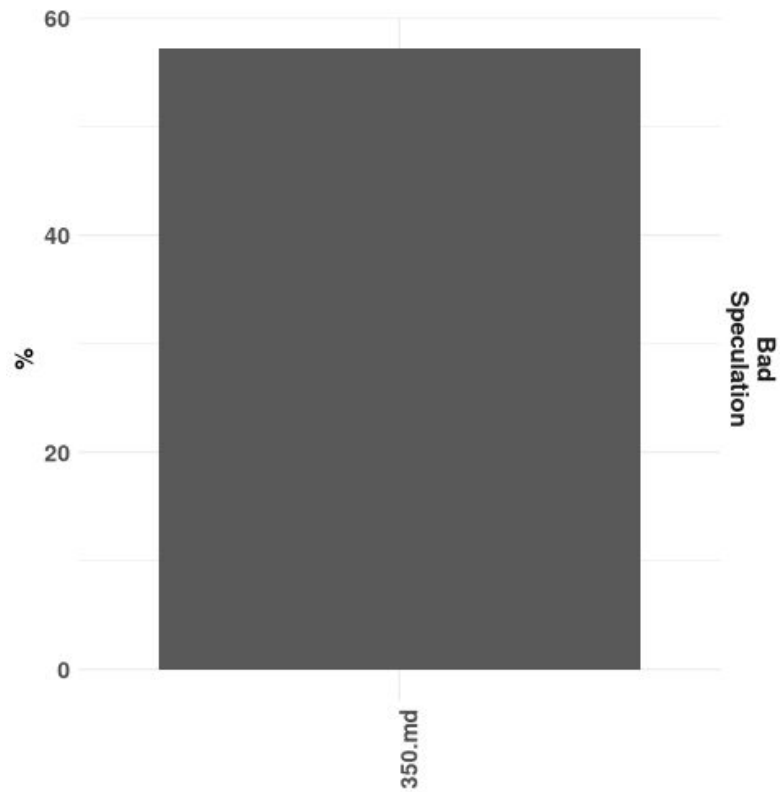
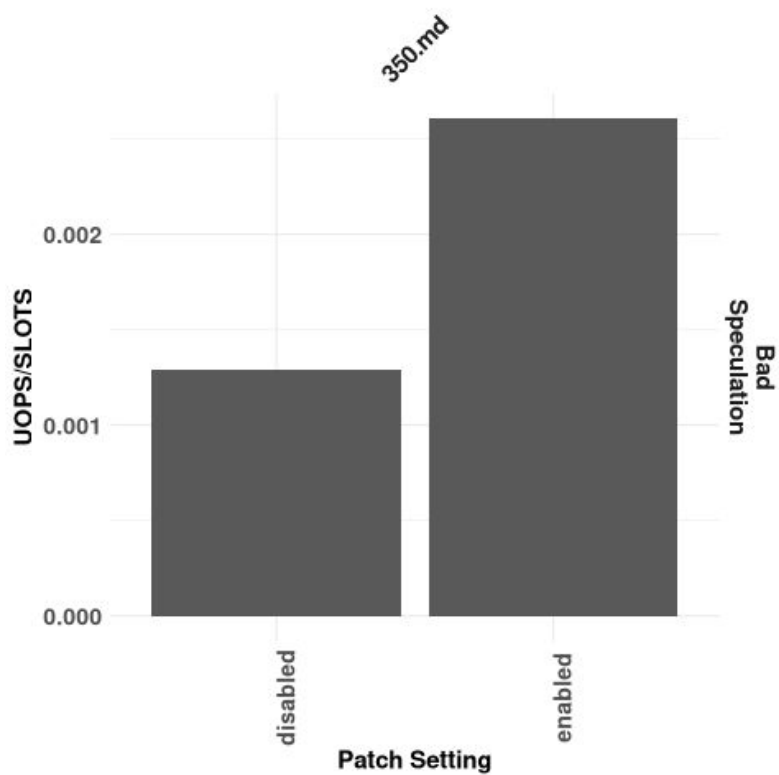
Experimental Setup

- Used SPEC OMP2012
- Intel(R) Xeon(R) Silver 4110 CPU @ 2.10GHz with 8 cores per socket, 2 threads per core
- Centos 7.6
- Compared
 - Intel 2021.1 compiler suite
- Patches were enabled/disabled by adding a 1 or 0 in
 - `/sys/kernel/debug/x86/ibrs_enabled`
 - `/sys/kernel/debug/x86/retp_enabled`
 - `/sys/kernel/debug/x86/pti_enabled`

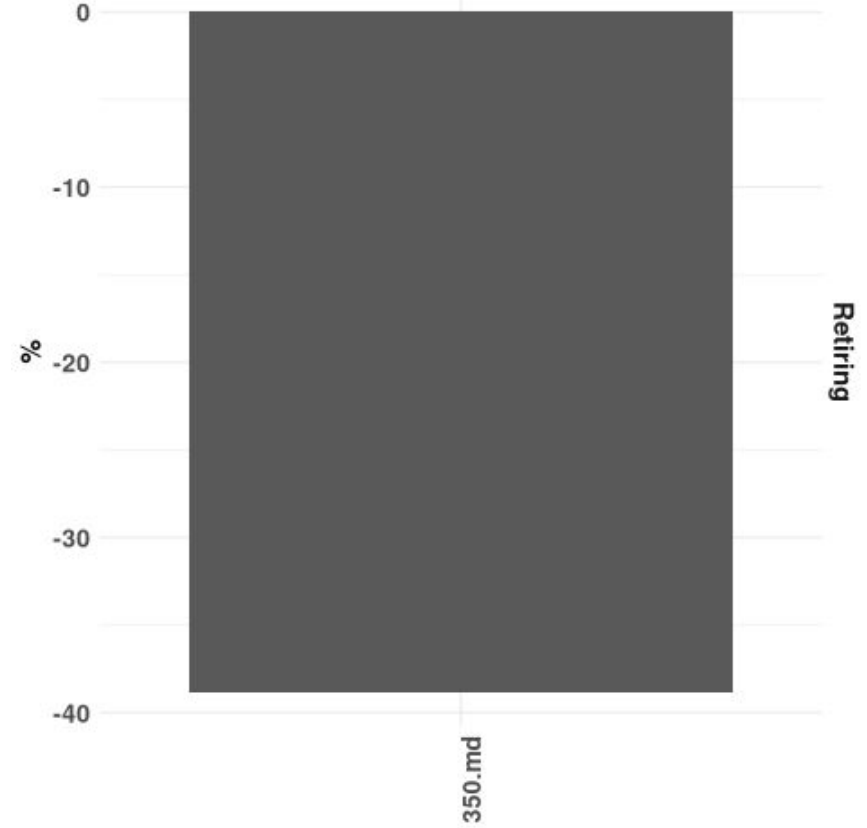
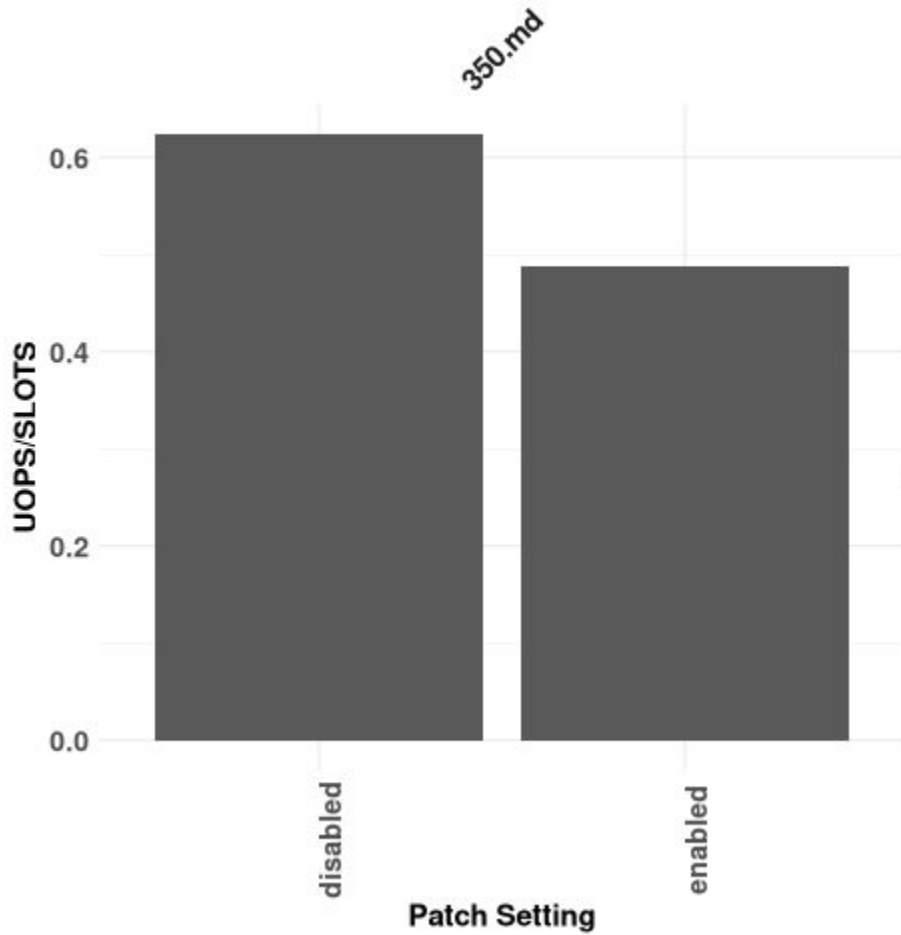
Runtimes



350.MD Top-Down Results for Bad Speculation



350.MD Retiring Results



Take Aways

- PPP normalized metrics make it possible to identify relative differences between rates
- It makes it possible to distinguish between similar rates
- Rates that are different can be amplified or reduced

Conclusions

- We showed that bottleneck profiles can differ
- We showed that relative rates can vary significantly
- We highlighted trends and differences in metrics